SN Ground Segment Sustainment Project

SGSS Customer Technical Interchange Meeting
November 21, 2013

Welcome and Project Introduction
Tom Gitlin

Customer TIM Purposes

- **The SGSS Project highly values the customers it will serve. This TIM is an opportunity to share information, receive feedback and engage in candid conversation**
- **SGSS is committed to keeping the end user community informed about the SGSS strategy, progress, decisions, and changes**
- **This TIM has the following goals:**
  - Update selected information provided at the last TIM
  - Inform customers of key SGSS status, milestones, events, and important dates
  - Convey high level details of the customer interfaces
  - Convey a general concept of the validation approach for customers

2nd Customer TIM – September 2012

- **The 2nd Customer TIM (AKA the "SGSS Customer Forum") was held last fall**
  - Topics discussed included : Scheduling Phases, Customer Interfaces, Scheduling and Data Interfaces, NISN/IP Addressing, Transition Period and Customer Testing, and SCaN Future Plans
- **At the 2nd TIM we forecasted we would be covering the following items at this TIM:**
  - Interface Definitions
    - Closure of ICDs
  - Focused on deployment and test activities

The Customer ICD addendum progress is behind schedule, but is proceeding

SGSS Coordination Status

- **A customer information section has been added to the SGSS website**

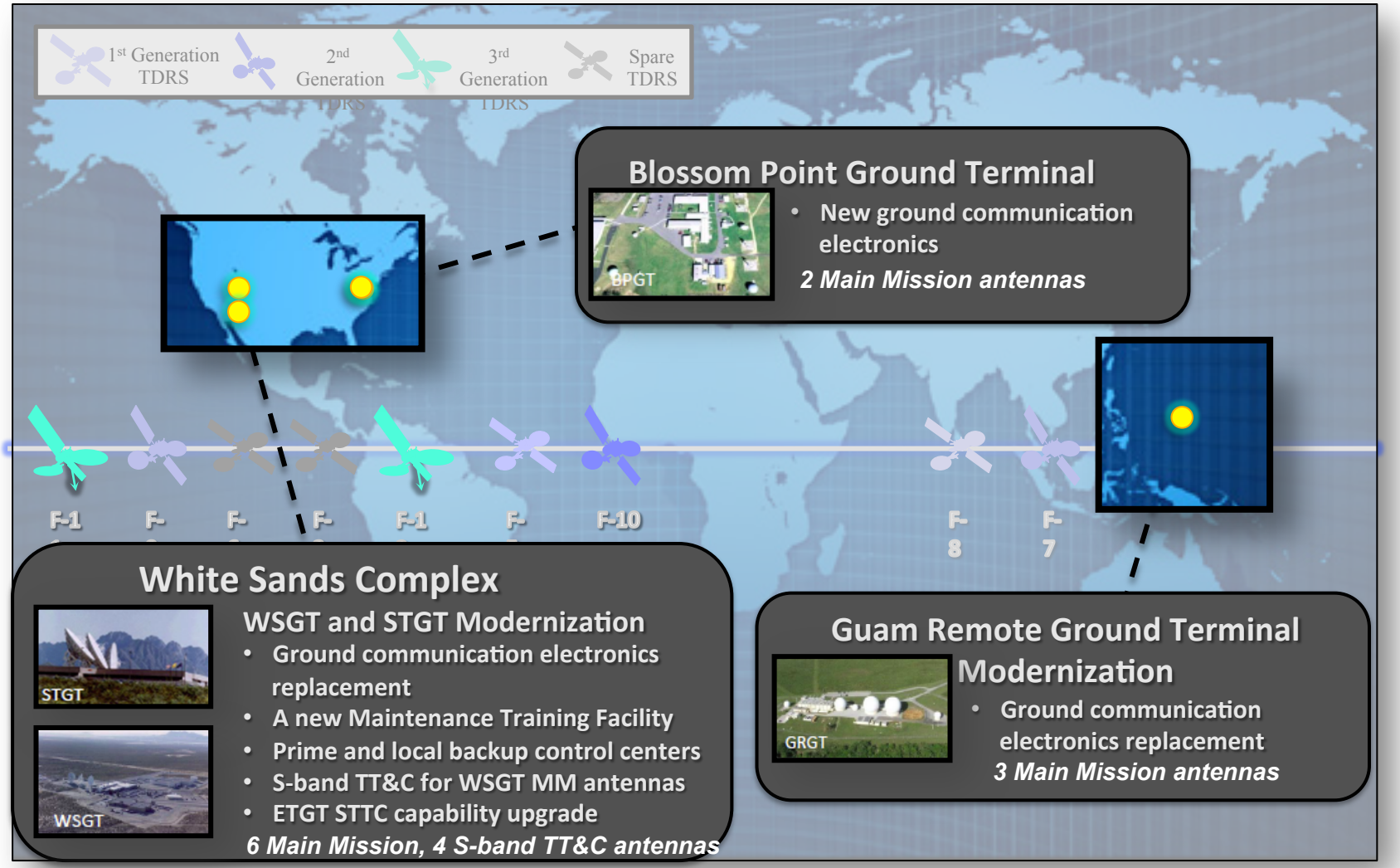
  http://esc.gsfc.nasa.gov/space-communications/sgss.html

- **The website contains these presentations and the periodic SGSS newsletters**

SGSS Background

- **The SGSS Project will develop and deliver a new ground system that will enable the Space Network (SN) to continue safe, reliable, and cost efficient operations for the next several decades**
  - The SN, a designated national resource, provides essential communications and tracking services to NASA human exploration & scientific missions and non-NASA missions
  - The current SN ground segment, developed in the mid 1990s, is based on obsolete technologies and is becoming increasingly difficult to operate safely and reliably
  - The SN space segment is being replenished with additional TDR spacecraft. TDRS-K was launched on Jan 30, 2013 and TDRS-L launch is planned for Jan 2014
- **SGSS will allow the SN to support an evolving customer set by:**
  - providing all of the capabilities and capacities required by current SN customer missions
  - expanding the capabilities and capacities of the SN to support new services for new customers in the near to mid term
  - delivering an extensible and expandable system to easily allow future modifications to implement services not yet defined
  - enabling reductions in operations and maintenance costs

SGSS Activities Across Diverse Geographies



SGSS Project Status

SGSS Functional Architecture

Maintenance &Training (MT)
- **Offline support for the SGSS**
- **System/SW maintenance, debug**
- **System-wide training access**

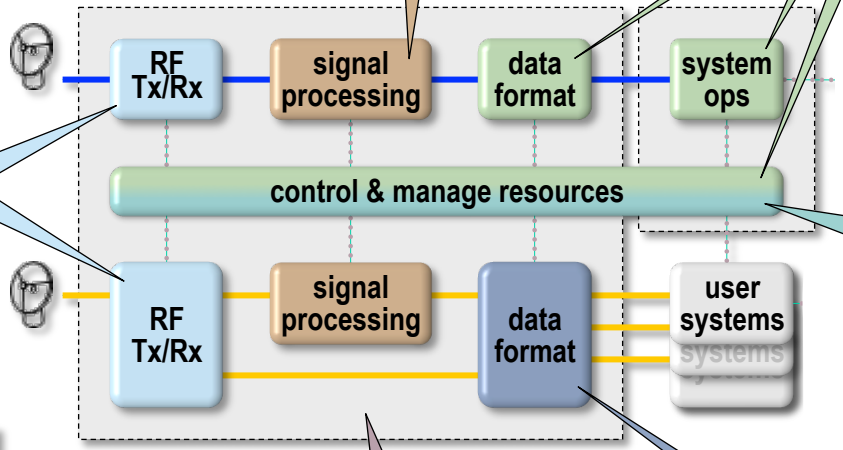
The MT element is not part of the operational system.

Digital Signal Processing (DSP)
- Convert analog <> digital signal
- Modulates, demodulates, encodes, decodes traffic
- **Ground-based beam-forming**
- High-Speed IF signal distribution

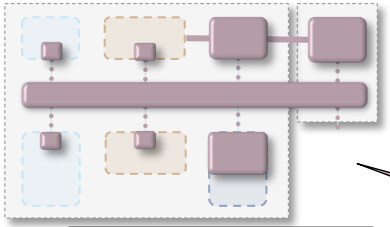
Fleet & Ground Mgmt (FGM)
- Control and manage the TDRS fleet
- **Manage the ground resources**
- Manage the entire SGSS enterprise

These element color codes are consistently used throughout our system documentation

Space-Ground Link (SGL)
- Forms the link between the antenna feed and the signal processing equipment
- Provide precise timing and frequency references



Service Management (SM)
- Plan, schedule, and execute user service sessions
- Monitor and report user service **performance**



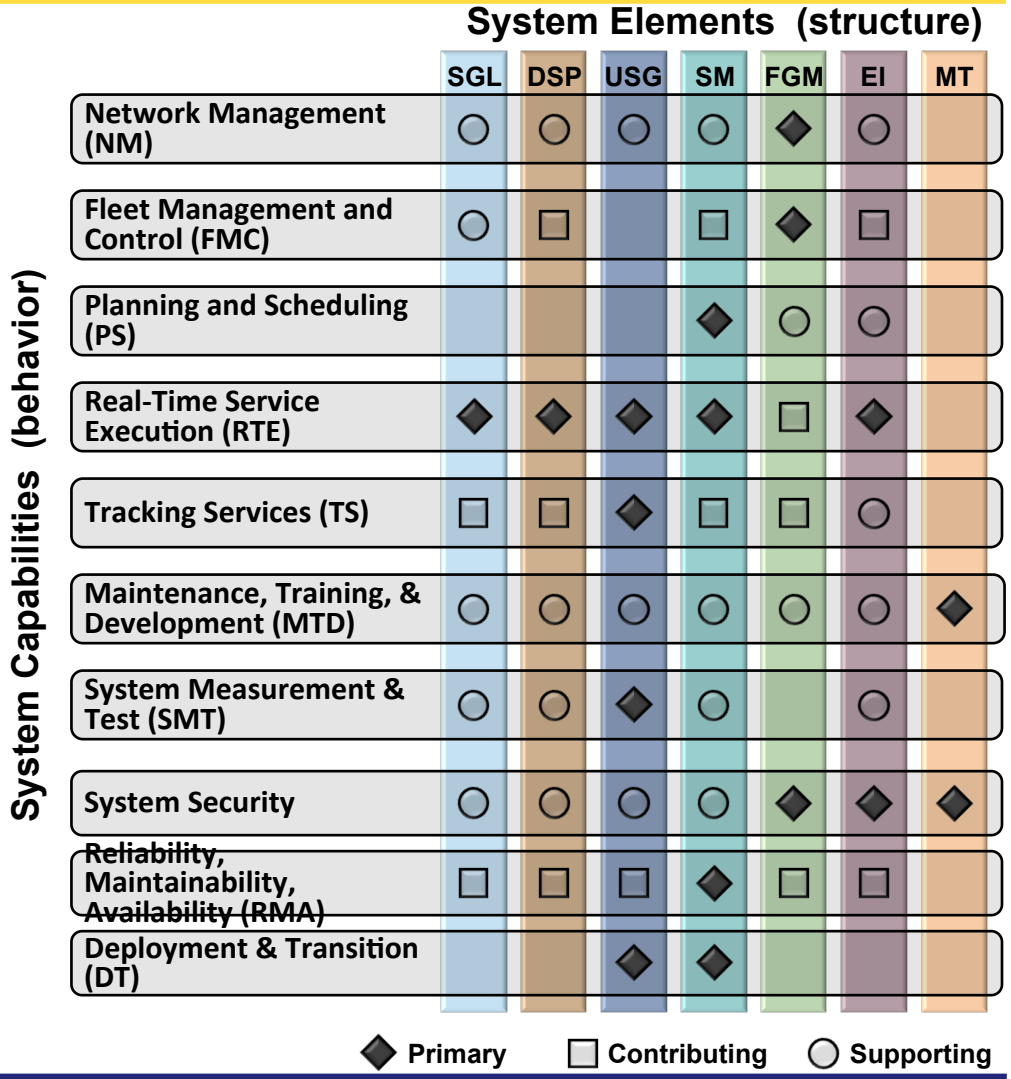
EI provides processing and networking, supporting and connecting the other elements

Enterprise Infrastructure (EI)
- **High-**availability operating environment to host applications system-wide
- Catalog of common *services*
- Internal system networking resources
- **Network/boundary protection**
- **CMD and TLM encryption/decryption**

User Services Gateway (USG)
- **External** interfaces for forward **and** return user traffic
- Data format, protocol translation
- Signal/baseband record and replay
- user service simulation for end-to-end testing

SGSS Elements and Capabilities

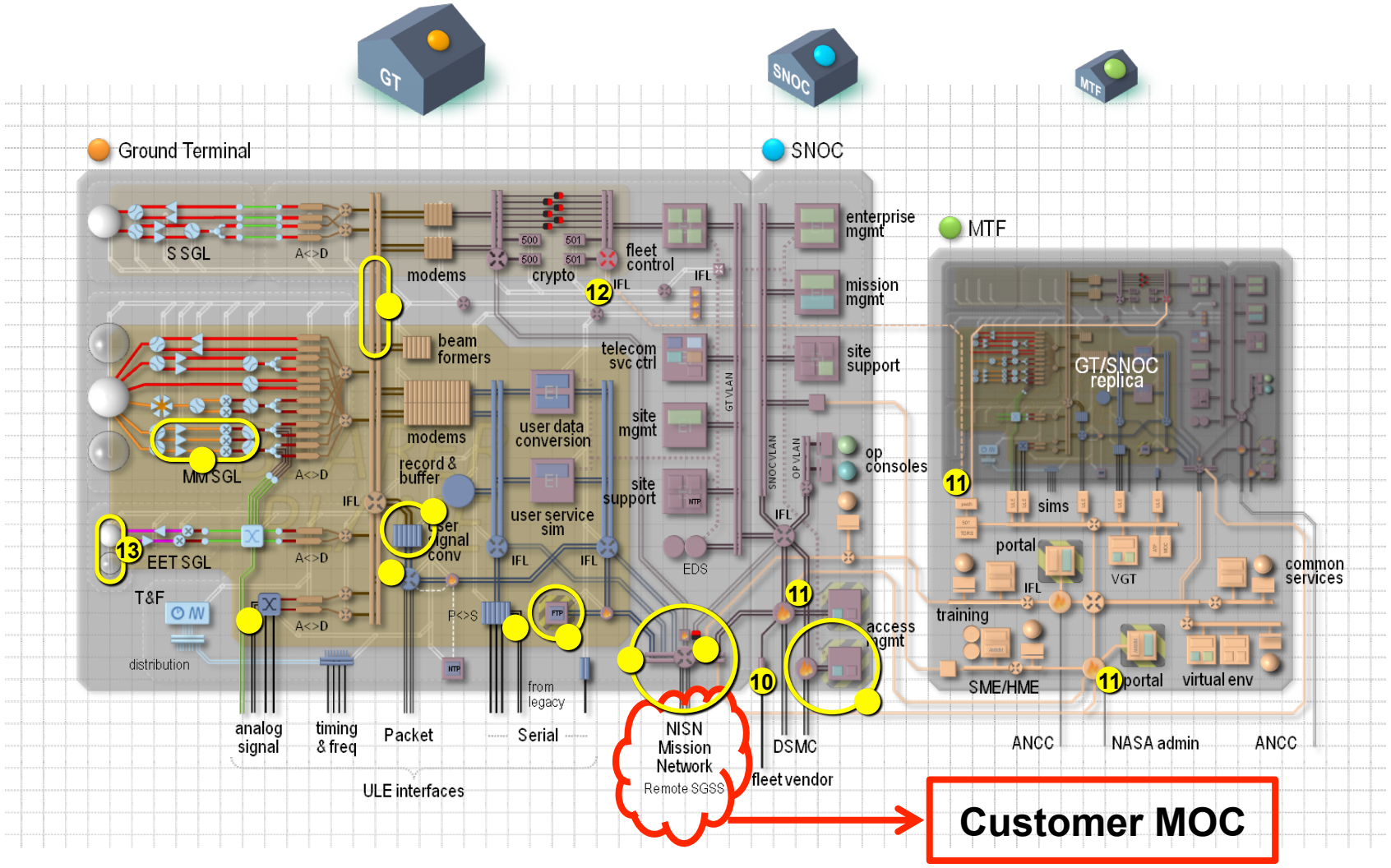
- **Defined and iterated the buildable element structure to implement behavior**
  - Directly building behavior is seldom advisable or efficient
- **To assure accommodation of system capabilities, ~250 functional threads have been developed**
  - Define multi-element coordinated behaviors
  - Derive element-level functional requirements and interfaces
- **Focused analyses derived related non-functional requirements**
  - Performance allocations
  - Security



Critical Design Review Results

- A series of element CDRs were conducted from early-to-mid 2013 that covered the detailed design for each of the building blocks of SGSS
- The System CDR was successfully held in June 2013

Composite Physical Architecture at CDR



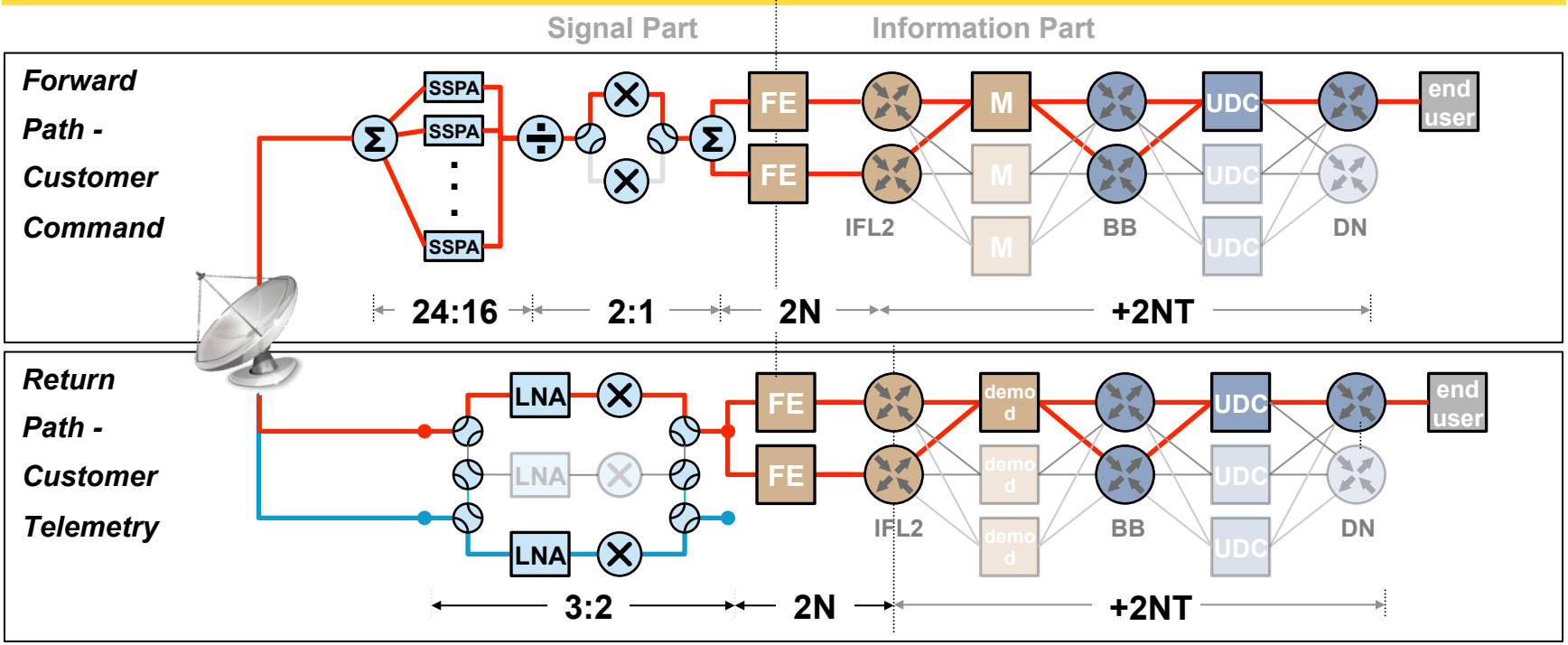
Specific Architecture Changes Since PDR

1. Consistent NISN L3VPN support for each SGSS site. Homogenizes site network connectivity, and eliminates separate intersite routers present in the previous design. Consolidates GT/SNOC external physical interfaces. End-user traffic, MT WAN now protected by IPSec site-to-site
2. Added distinct and separate DMZ for SN local network users
3. Added bearer-plane DMZ to host SFTP end-user data file services
4. IPSEC replaces type-1 HAIPE for intersite transport of MT and bearer networks
5. Consolidation of TTC and user IF switching. VLANs used to retain isolation.
6. LNA redundancy changed to 3:2 from dual 2:1
7. Legacy adapters for analog and serial ULE interfaces now integrated into the LI
8. Digital IF service to ULE no longer routes through the DN.
9. Firewalls removed from IF service links to UN/ULE. Replaced with switch-hosted detection and reporting
10. Fleet vendor interface is now serial
11. New accesses added to MTF. Operator access to AM. NASA admin LAN access. TDRS simulation link to operational system for testing.
12. TTC red LAN extended via IFL to allow TDRS sim access to WSGT.
13. Reduction of supported EET antennas per site. 1 Ka, 1 Ku/S.

Notable Architecture Changes Since PDR

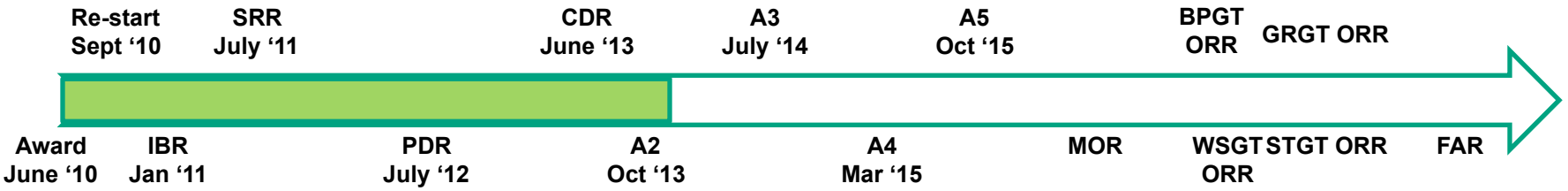
- End user service redundancy (known as +2NT, or improved dual redundant network transport)

End-user Service Redundancy
+2NT (Improved Dual Redundant Network Transport)



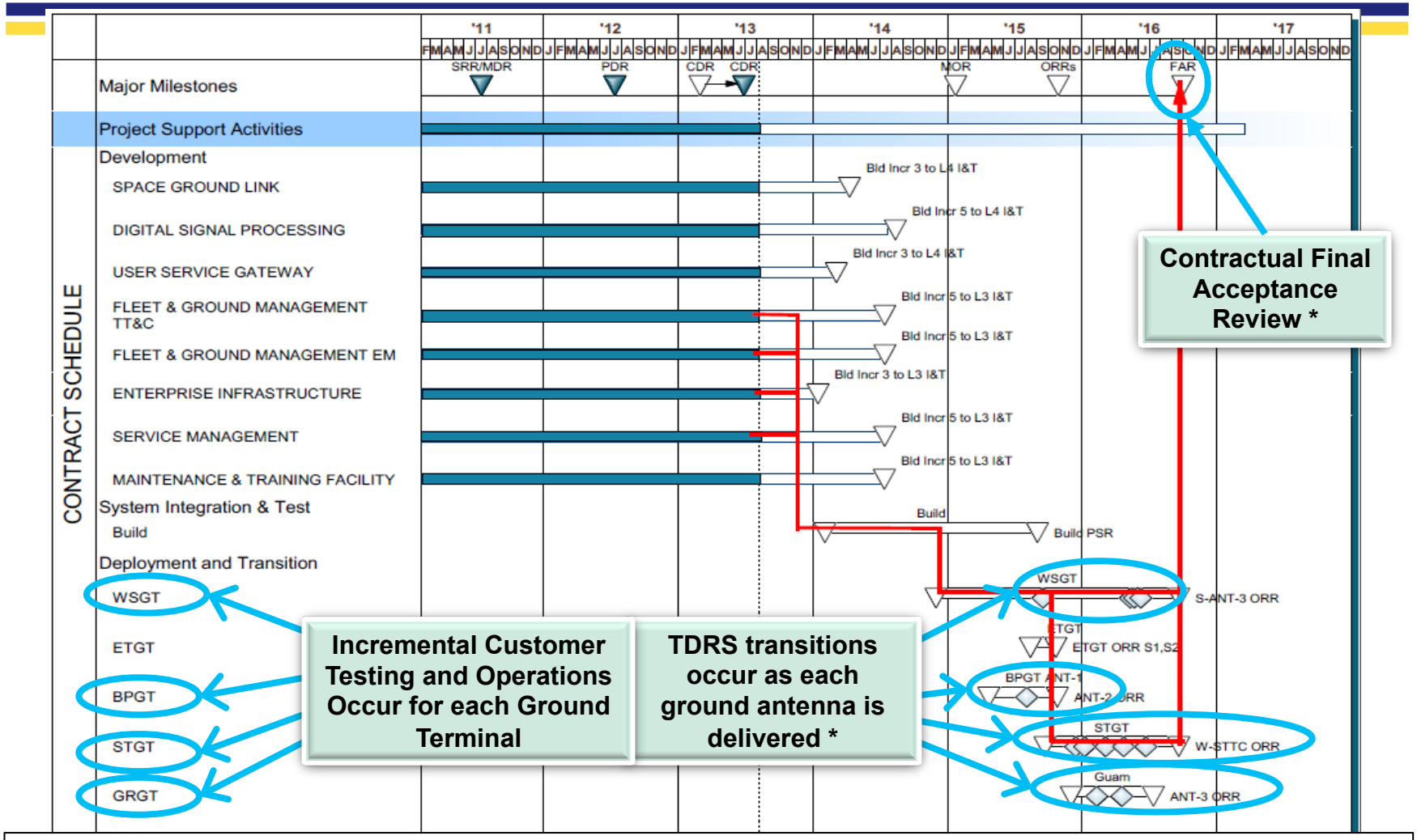
- **Pooled redundant "information part" hosts provides redundant streams, Full active redundant networks**
- **Very high data recovery performance**
- **Essentially eliminates baseband frame losses**
  - Eliminates multiplying effect for specific forward service interruptions
  - Significant service recovery simplification

Program Milestones Achieved



- The Technical Baseline is captured in:
  - ~900 documents and drawings
  - ~630 CDRL submissions
  - ~17,000 Element CDR slides
  - **~29,000 Level 4, 5 and 6 Requirements in DOORs database**
- **Responded to 166 RFAs and 85 ADVs from Element CDRs**
- **Since program inception, conducted:**
  - **2,086 ITAs**
  - **2,374 TPRs**

SGSS Schedule



** The project has experienced cost and schedule growth and is undergoing a comprehensive management review. The schedule shown above is the baseline schedule; current estimates to complete indicate a significant slip to the transition and final acceptance dates (>16 months beyond those shown)*

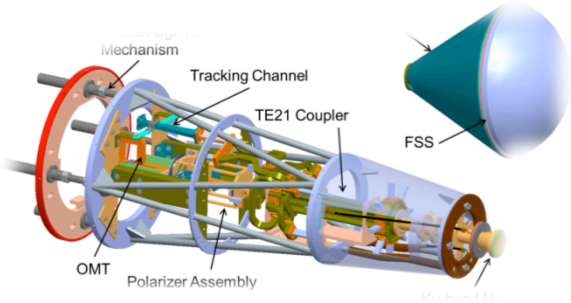
Selected Progress - Highlights

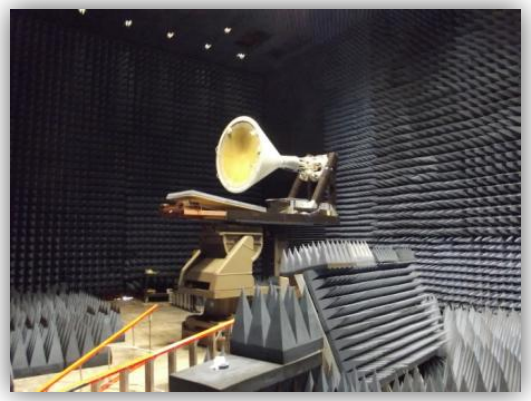
- The GD (Scottsdale, AZ) Remote Development Facility (RDF) buildup is progressing
- There are four distinct increments of software planned, the first increment has completed Level 1/Level 2 integration

RDF3 Assemblies at GD in Scottsdale, AZ

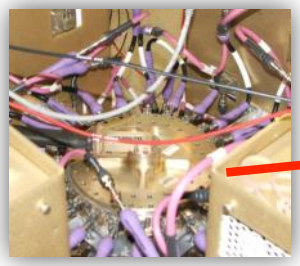
Selected Progress – Highlights (Cont'd)

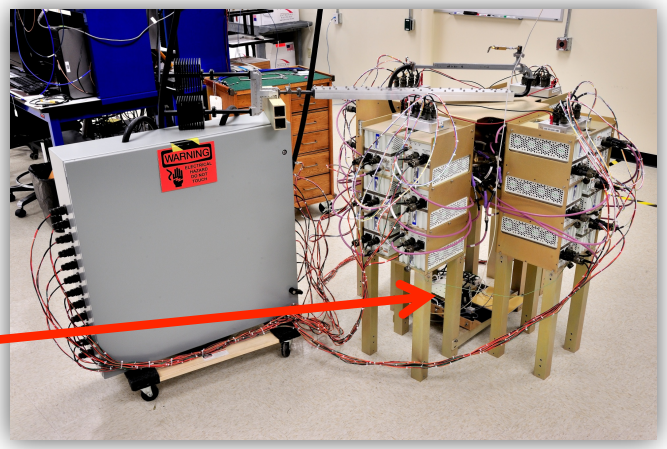
- The Space Ground Link (SGL) Dual Band Feed (DBF) assemblies are built and are undergoing testing at Harris in Melbourne, FL
- SGL Up/Downconverter cards have been built and are undergoing test
- The SGL Ku-band SSPA combiner/divider has been built and tested, including a full compliment of Solid State Power Amplifiers (SSPA)
- An Antenna Control Unit (ACU) was recently taken to WSC and it successfully controlled a Ka End-to-End test antenna





Dual Band Feed Assembly for the WSGT 18.3m Antennas

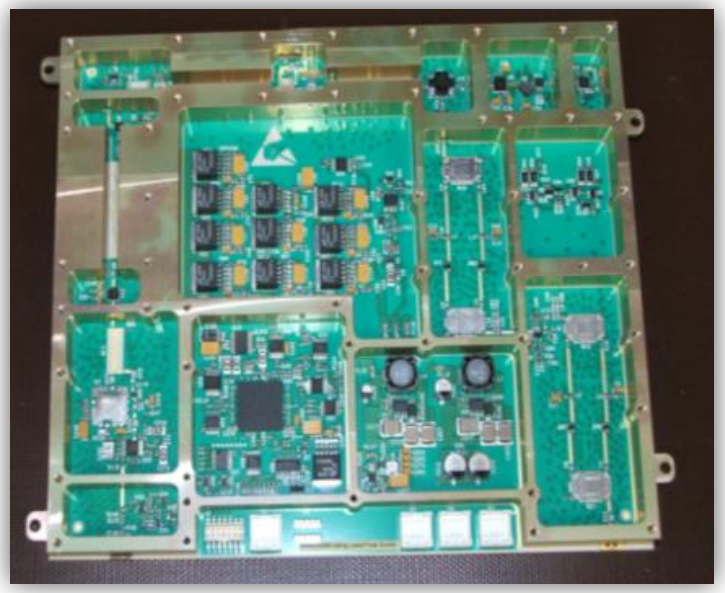




Ku-band SSPA assembly with combiner/divider and 24 amplifiers

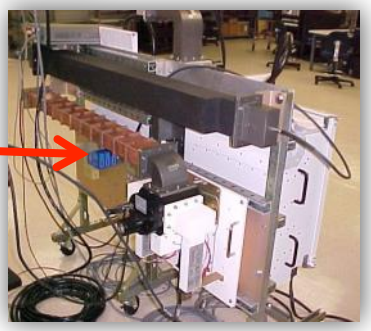
Selected Progress – Highlights (Cont'd)

- SGL Up/Down Converters
  - Prototypes built and tested
  - Production underway



STTC and TFS Subsystems Maturity

- Completed STT&C prototype and shipped to Scottsdale to support early integration activities
- NMSU completed the Timing and Frequency Reference Subsystem for the RDF and provided a unit to GDC4S in Scottsdale and Harris in Palm Bay to support integration

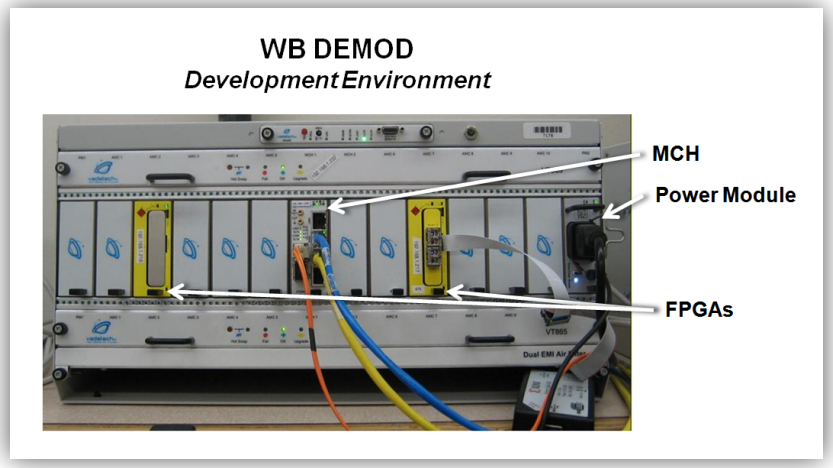


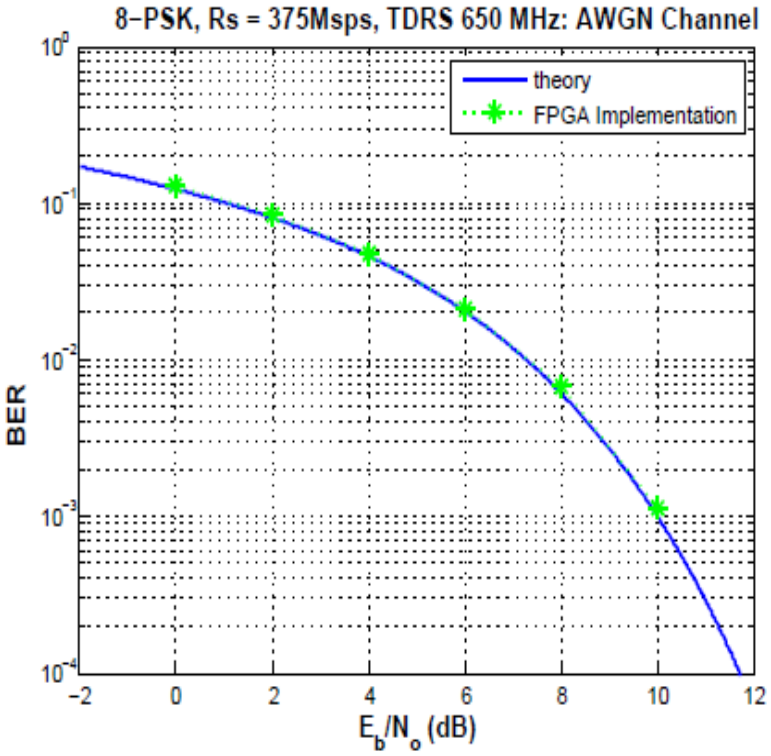
SGL STT&C Prototype

Timing and Frequency Reference Subsystem

DSP Modem Maturity

- The Digital Signal Processing (DSP) Narrowband and Wideband (WB) Modulator/Demodulator development is proceeding well
- Early WB testing shows excellent performance against theory

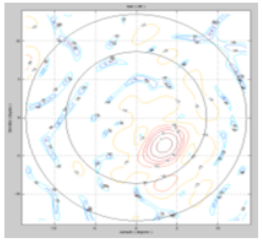




Representative BER Curve from recent testing of the Wideband Demod (Modem)

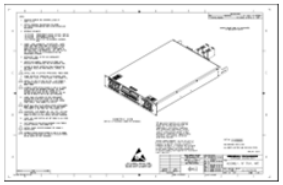
DSP Subsystems Maturity

Beamformer Adaptive Nulling



DSP

Formal Verification
L3 Integration
Lab Development
Test Planning



Beamformer

MMA Front End

Formal Verification
Prototype
CDR
PDR

Other Front Ends

Formal Verification
Prototype
CDR
PDR

RF Trays

Formal Verification
Prototype
CDR
PDR

High Speed Switch

Formal Verification
Prototype
CDR
PDR

Wideband Test Tx

Formal Verification
Prototype
CDR
PDR

Wideband Rx

Formal Verification
Prototype
CDR
PDR

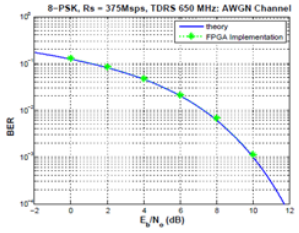
Narrowband Tx

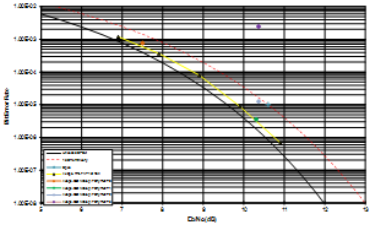
Formal Verification
Prototype
CDR
PDR

TT&C

Formal Verification
Prototype
CDR
PDR

WB DEMOD
Development Environment





EI Hardware Subsystems Maturity

Enterprise Infrastructure

M&C + TTC Networks

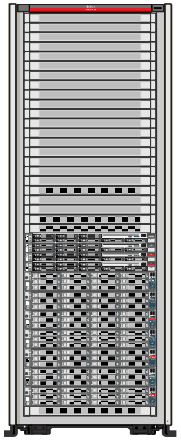
Enterprise Data Storage

High Availability Operating Environment

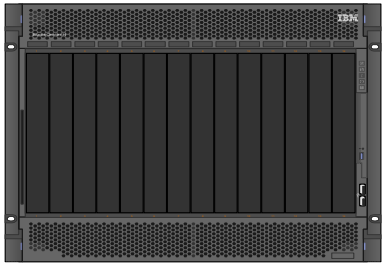
Cisco 5596

Cisco 3560

EMC VNX5500



Oracle Exadata

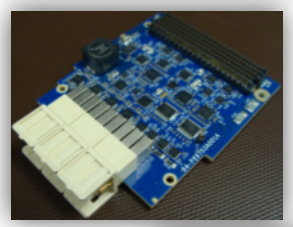


IBM HS23 Server Blades with Blade Center H24 Chassis

USG Hardware Subsystems Maturity

- Completed functional and performance testing of USG RBS racks for STGT, WSGT, and GRGT
- Commenced testing of Local Interface FPGA cards
- Completed Testing the DSP High Speed Switch for RDF, STGT, and WSGT

DSP HSWT Testing at Harris in Palm Bay, FL



USG Integration Lab at Harris in Palm Bay, FL

Moving Forward

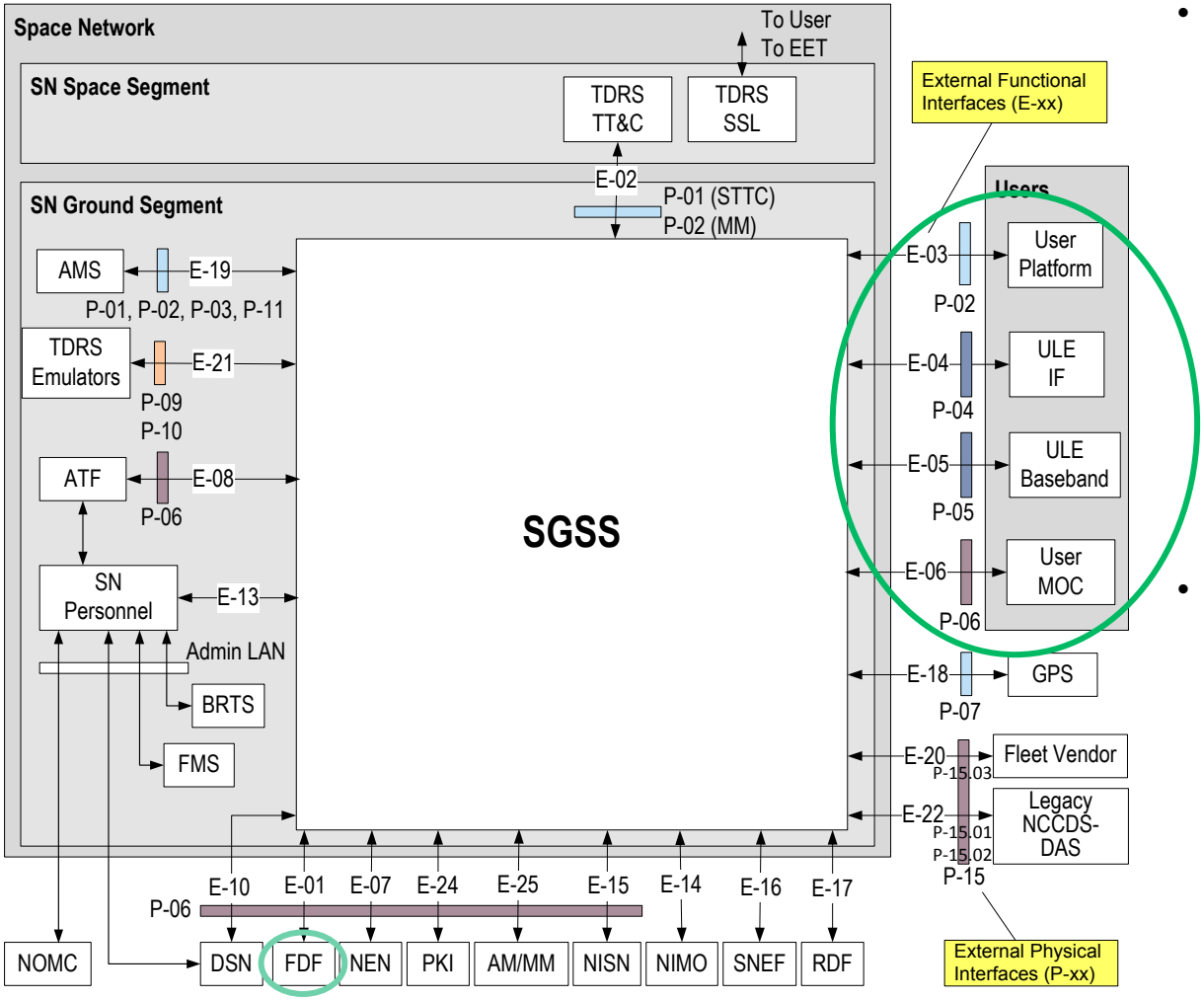
- Continue ICD development and approval
- Continue working technical issues and other details

Customer Interface Overview
Nicole Loomis

Customer Interface Agenda

- **Agenda**
  - External Interfaces (Customer Focus)
  - External ICD Status
  - External ICD and User Addenda
  - User Addenda Process
  - User Addenda Status and Schedule

Customer Interfaces to SGSS



- **The SGSS Prime Contractor (General Dynamics) is developing Interface Control Documents (ICDs) to define all SGSS Interfaces.**
  - Internal ICDs are defining the SGSS Subsystem interfaces.
  - External ICDs are defining the interfaces between SGSS and external entities/ elements.
- **Key External Root ICDs include:**
  - User Platform
  - ULE Intermediate Frequency (IF)
  - ULE Baseband
  - User MOC
  - NISN
  - FDF

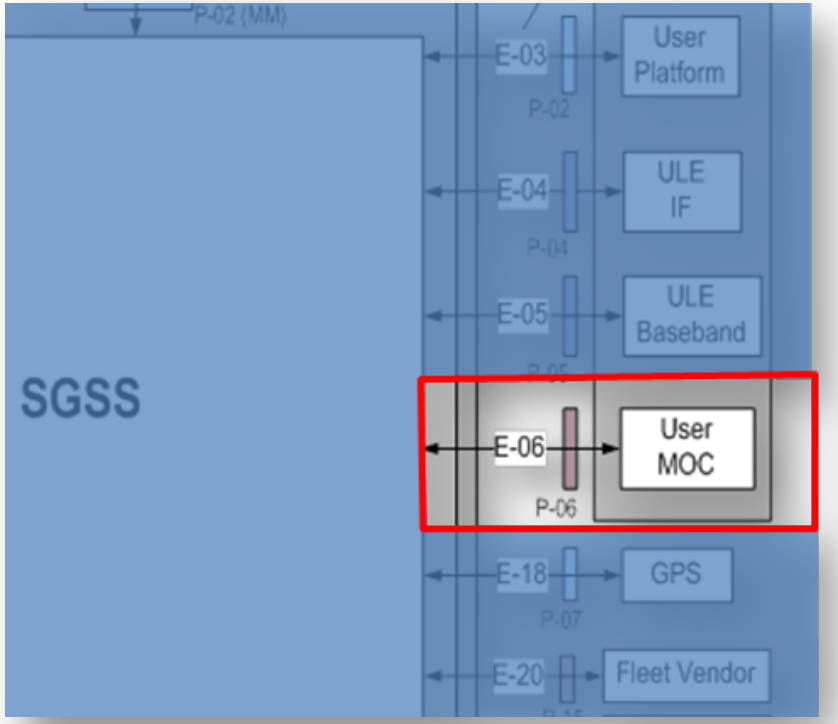
External ICDs (SGSS-xx) Status

- **All external ICDs (Rev C) reviewed with feedback provided to GD**
  - 10 Approved with Comments
  - 4 Pending due to dependencies and impacts to User Addenda (*)
  - 4 Disapproved due to lack of data within ICD
- **Updates**
  - Rev D is the next release to NASA
  - GD is currently working on Rev C.1 (for internal-GD use)
- **Plan for ICDs "not approved"**
  - Validate User Addenda (in progress)
  - FV, AMS: Rev C.1 reviewed
  - FDF, DSN: Updates in progress

ICD	Disposition
FDF	Disapproved
TDRS T&C	Approved with Comments
User Platform	**Pending***
ULE IF	**Pending***
ULE BB	**Pending***
User MOC	**Pending***
NISN & Addendum	Approved with Comments
NEN	Approved with Comments
ATF	Approved with Comments
DSN	Disapproved
RDF	Approved with Comments
AMS	Disapproved
FV	Disapproved
TSE (TDRS K/L)	Approved with Comments
NCCDS-DAS & Addm	Approved with Comments
NASA PKI	Approved with Comments

External ICD/User Addendum Relationship

Example User MOC ICD



- **User MOC ICD**
  - The main User MOC ICD is a compilation of all possible options that could be implemented to support User MOC interfaces.
- **User Addenda**
  - Contractor is developing a set of User Addenda to identify specific support characteristics
  - One addenda per user (or group of users) currently using the Space Network (SN)
  - Assist in the interface design for SGSS
  - Assist in common understanding of SGSS support of User needs
- **The addenda are capturing details of the current interfaces**
  - Used as a design tool for development and transition to the new SGSS interfaces
  - Ensure support for the user services currently scheduled/used.

User Addendum Sample

- **User Addenda Built Using 3 main categories (templates)**
  - PTP (WDISC/SN GW)
  - MDM (NASCOM 4800 BB)
  - ULE (LI at GTs)
- **Each User Addendum Addresses**
  - scheduling
  - freq/time references
  - tracking
  - FWD
  - RTN

References to Root ICDs

Real time Service Control and Monitor messages exchanged between SNAS a
formatted in accordance with eXternal Data Representation (XDR) guidelines
guidelines include:

- Message Delineation, see Appendix C.2 of E.06
- Message Content Data Rules, see Appendix C.4 of E.06
- Character Format, see Appendix C.5 of E.06
- Time Format, see Appendix C.6 of E.06
- Data Item Ground Rules, see Appendix C.7 of E.06

Section	Title	SN Services	<Mission> Applicability
1	**Scope**		
2	**Referenced Documents**		
3	**Management Services**		
		Service Scheduling	Applicable
		Ephemeris – IIRVs	Applicable
4	**Control Services**		
		Real Time Service Control and Monitor	Applicable
		Tracking Data	Applicable
		Frequency References	Not Applicable
		Time References	Not Applicable
5	**Forward Link Bearer Plane (FLBP)**		Applicable
6	**FLBP Ground Link Services (Data Format)**		
		IF ULE Interface	Not Applicable
		Serial Baseband ULE Interface	Not Applicable
		UDP Baseband MOC Interface	Not Applicable
		TCP Baseband MOC Interface	Applicable
7	**FLBP Space Link Services (Signal Processing)**		
		Frame Processing	Not Applicable
		Bit Processing	Applicable
		Symbol Processing	Applicable
		Modulation	Applicable
8	**FLBP Space Link Services (RF Tx/Rx)**		
		TDRS to User Platform RF T	Applicable
9	**Return Link Bearer Plane (RLBP)**		Applicable
10	**RLBP Space Link Services (RF Tx/Rx)**		
		User Platform to TDRS RF Rx	Applicable
11	**RLBP Space Link Services (Signal Processing)**		
		De-Modulatio	Applicable
12			
		TCP Baseband	
13	**RLBP Record and Retrieve Services (Data Format)**		

Specific to your mission

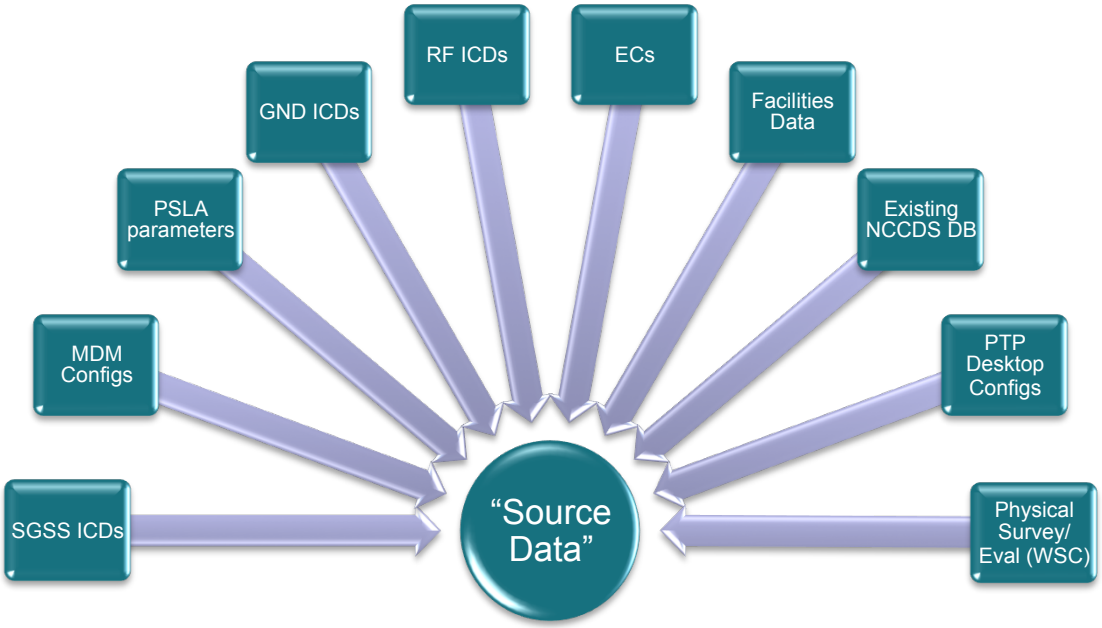
Table 4-1: Real Time Service Control and Monitor

Access Method	Appli... Me...
SNAS	SN-CSM

Table 10-1: RLBP User P...

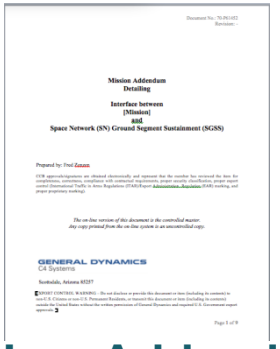
SSC ID	Service Type	Platform to TDRS Frequency (Hz)	Auto-Track	Min E... (0.1 d...
101	SSAR	2282500000	N/A	-50

Genesis of a User Addendum



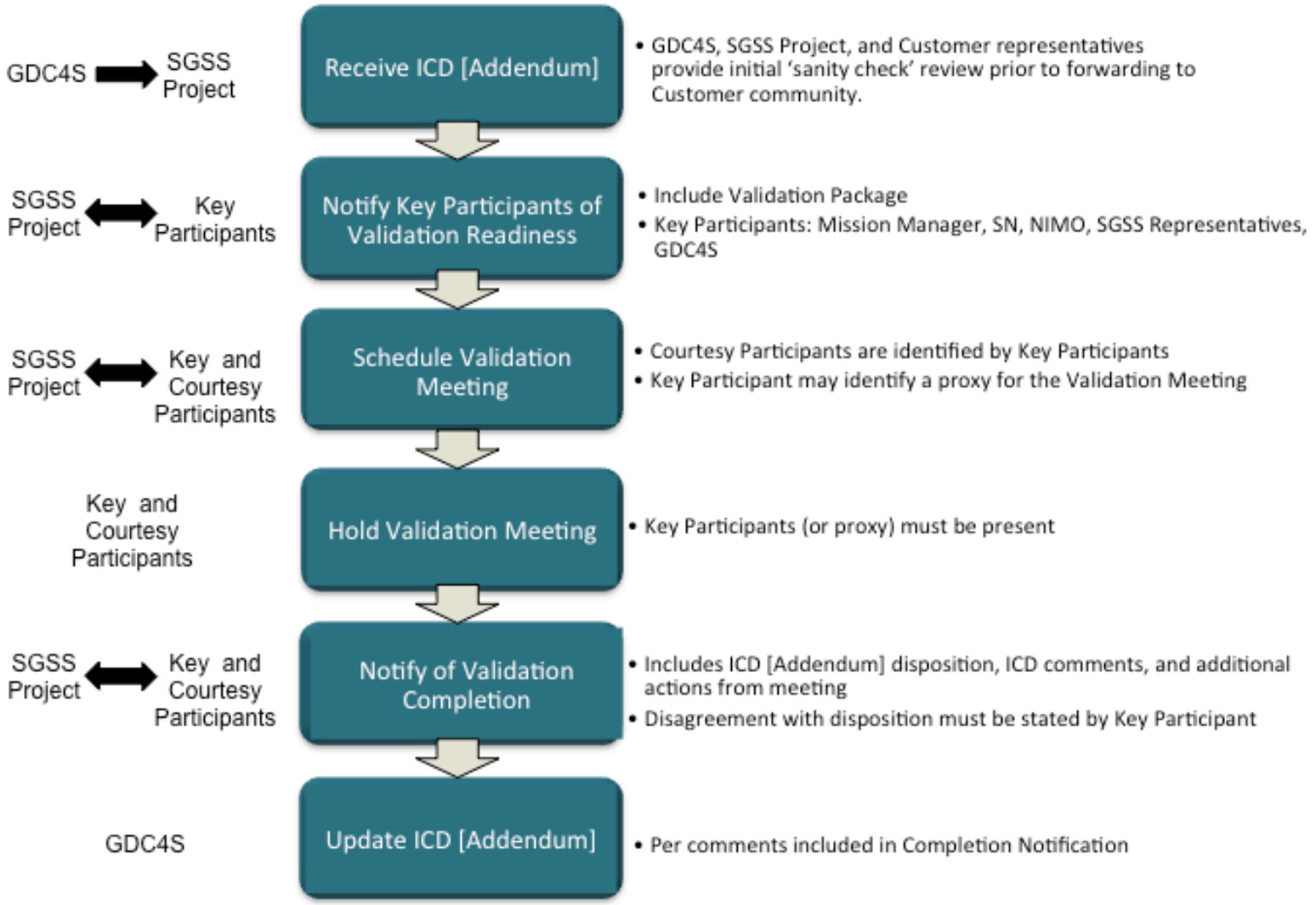
- **Data was collected from User representatives, NIMO, SN, and SGSS**
  - Overlaps and gaps were addressed.
  - Resulting "Source Data" has received significant review
  - Templates reviewed independently
  - Source Data was used as inputs into one of the 3 templates
- **User Addendum contains user-specific information to be used at SGSS access points (i.e., interfaces, databases).**

- UIFC-port mappings
- SSC service mappings
- UIFC-SSC linkage
- Service definitions
- Access methods/points



User Addendum

Addendum Review Process



Addendum Review Process Details

- **Notification email (of Validation Meeting) sent to Key Participants**
  - Notification sent by SGSS Project
  - Key participants negotiate validation meeting time
  - Key participants identify representatives (including proxy if desired) to Validation Meeting
    - These become Courtesy Participants
  - Includes Validation Package
- **Meeting invitation sent to Key and Courtesy Participants**
- **Validation Meeting**
  - Key Participants or proxies must be present
    - Meeting will be rescheduled if all required representatives are not present
- **Completion Notification Email sent to all participants**
  - Sent by SGSS Project
  - "To" Key Participants
  - CC to Courtesy Participants
  - Meeting includes
    - Disposition (e.g., Approved with Comments)
    - Comments (if any)
    - Additional notes or actions (if any)
- **{Optional} Disagreement with disposition requires email response to Completion Notification**

Note: Validation meeting *not* required if User representative agrees that it is not needed.

User Addendum Status

- **Since sCDR …**
  - User Addendum template was updated per User Input received during early Addendum reviews
    - One each of MDM, PTP, and ULE
  - All addenda will be re-reviewed with data in final format
- **Addenda Review Status (11/14/2013)**
  - Total Addenda: 55 (60 missions)
  - Early review (previous template): 20*
  - In generation: 18
  - In review: 16
    - Requires Customer/User Review
- **Schedule**
  - GD projected completion: January, 2014
  - Approximately 6 addenda per week

*Notable because data was reviewed (with comments incorporated), resulting in streamlined final review.

2 Weeks for User Review

ULE Users - non SPM (8)	**Fri 10/25/13**	**Fri 12/20/13**	**41 days**
Group 1A Development (Aqua, Aura, TERRA)	**Fri 10/25/13**	**Fri 12/6/13**	**31 days**
Re-generate Addenda using revised template	Fri 10/25/13	Fri 11/1/13	6 days
Review Addenda with User Services WG and update as required. Send to Users (NASA)	Tue 10/29/13	Tue 11/5/13	6 days
User Review	Wed 11/6/13	Tue 11/19/13	10 days
Disposition Comments and make final updates	Wed 11/13/13	Fri 11/22/13	8 days
Conduct TPR, release documents and provide to NASA	Mon 11/25/13	Fri 12/6/13	10 days

POCs

- **Customer Advocates**

	Phone	Email
Drew Ortner (SPM)	301-286-1985	andrew.j.ortner@nasa.gov
John Smith (non-SPM)	301-286-1932	john.a.smith@nasa.gov

- **User Addenda (MOC ICD) Coordinators**

	Phone	Email
Nicole Loomis (SPM)	301-286-5428	nicole.loomis@nasa.gov
Colleen McGraw (non-SPM)	301-286-9941	colleen.a.mcgraw@nasa.gov

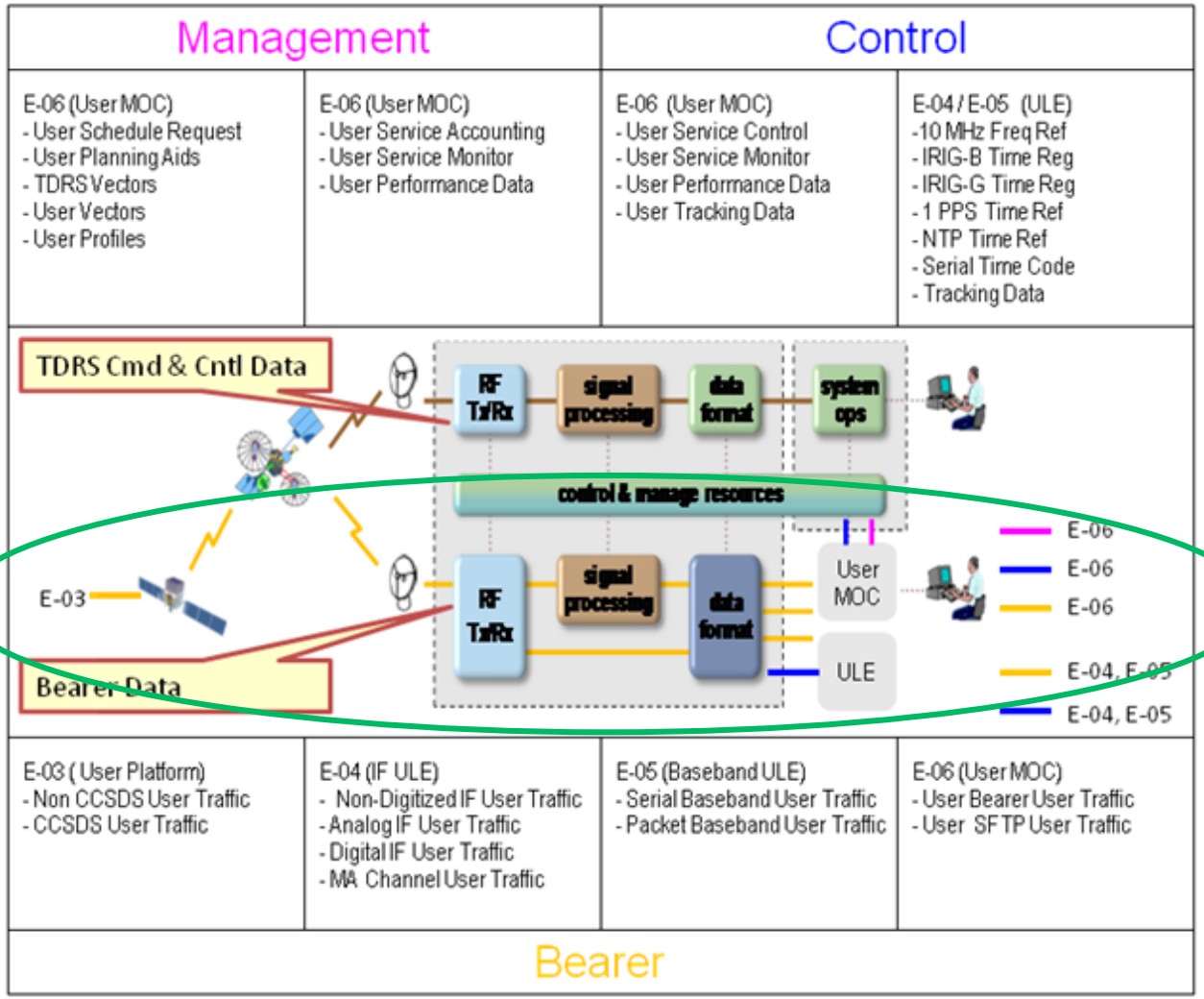
Next Steps

- **Please review your Addendum**
  - 2 week review time
  - Validate the data included
  - Identify unneeded SSCs
  - Provide feedback

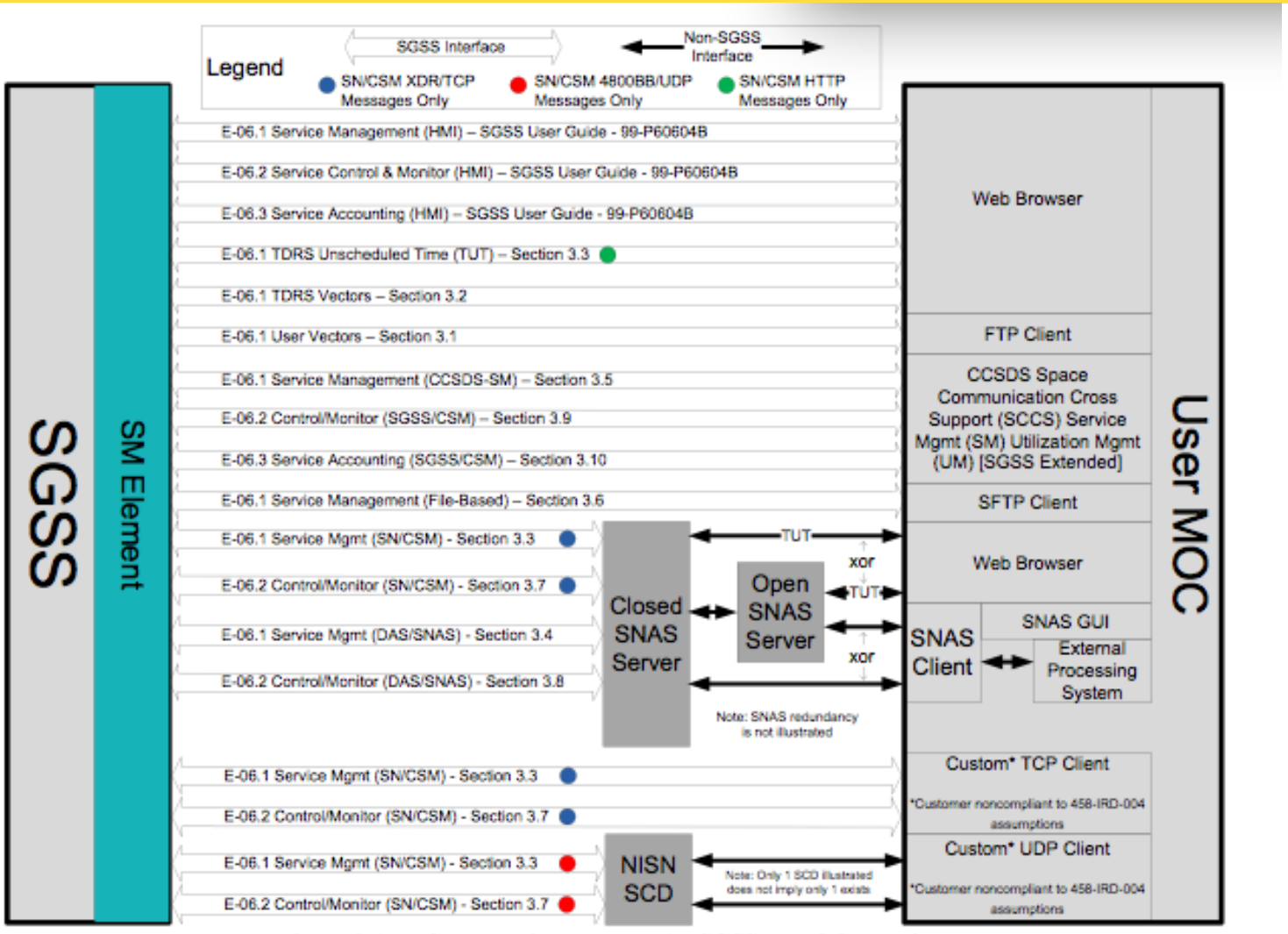
- **If you have any questions, please contact either the Customer Advocate or SGSS Representative**

Backup Slides

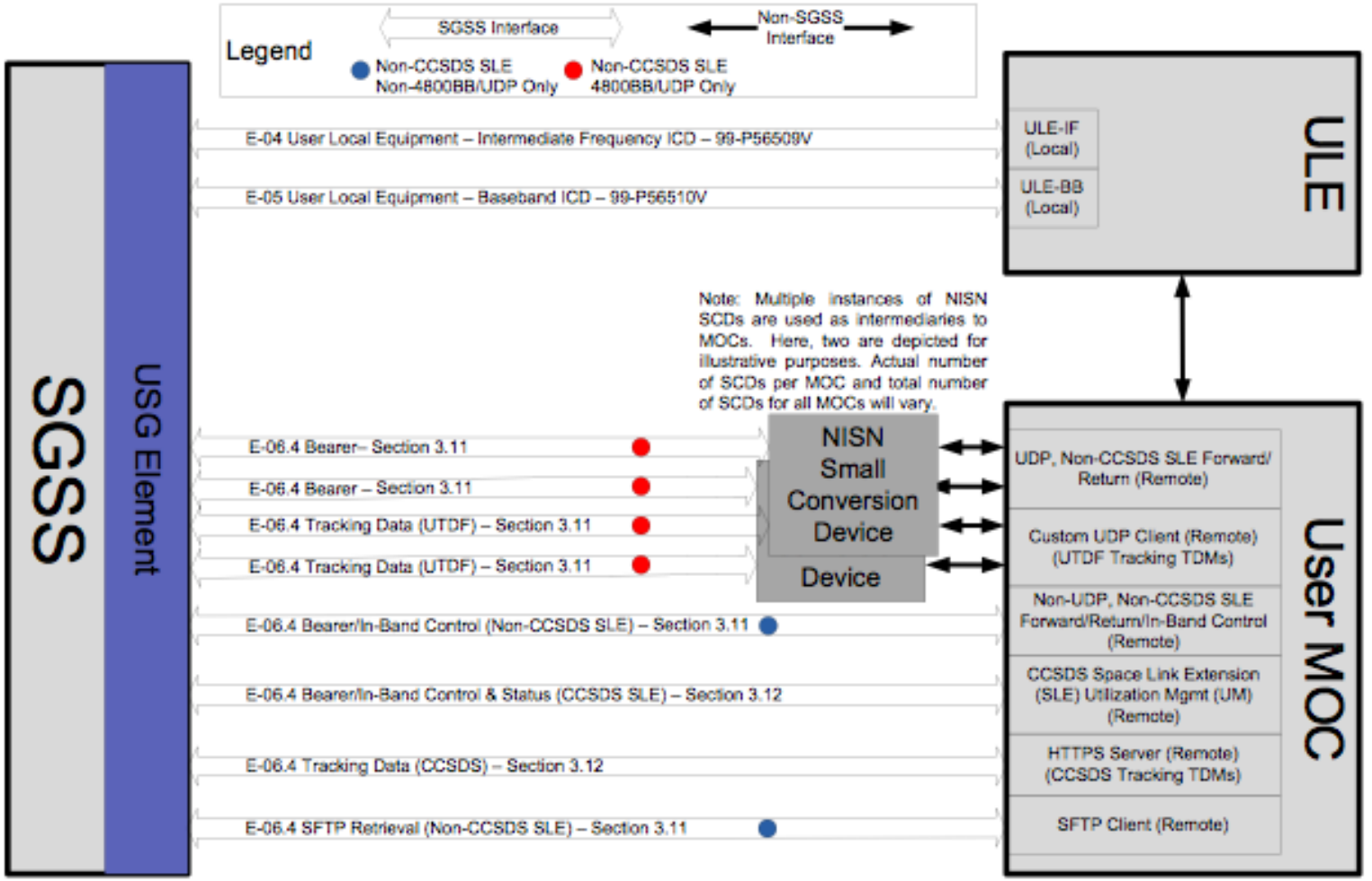
Basic Data Flow Through SGSS



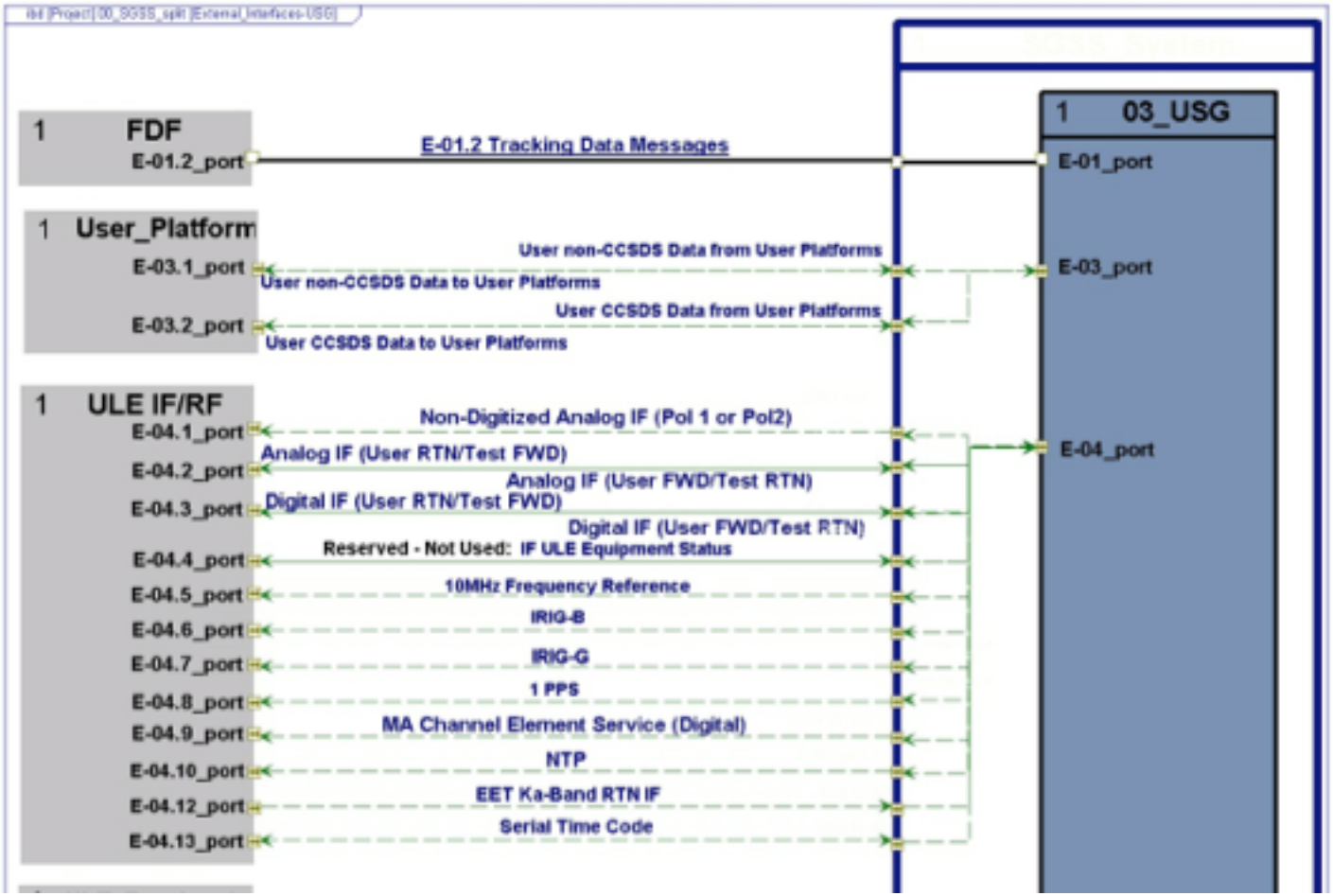
User MOC Interfaces (Schedule/Monitor)



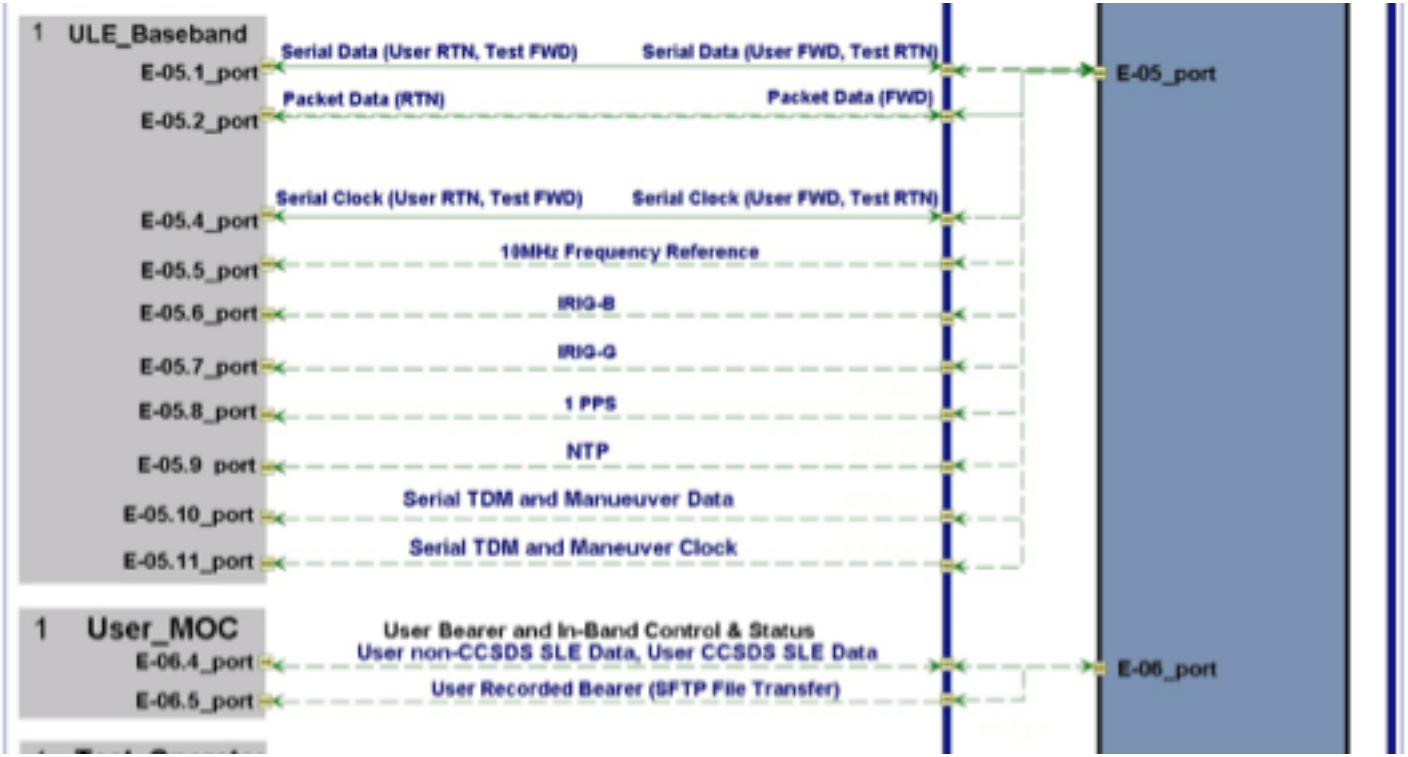
User MOC Interfaces – FWD/RET/Tracking



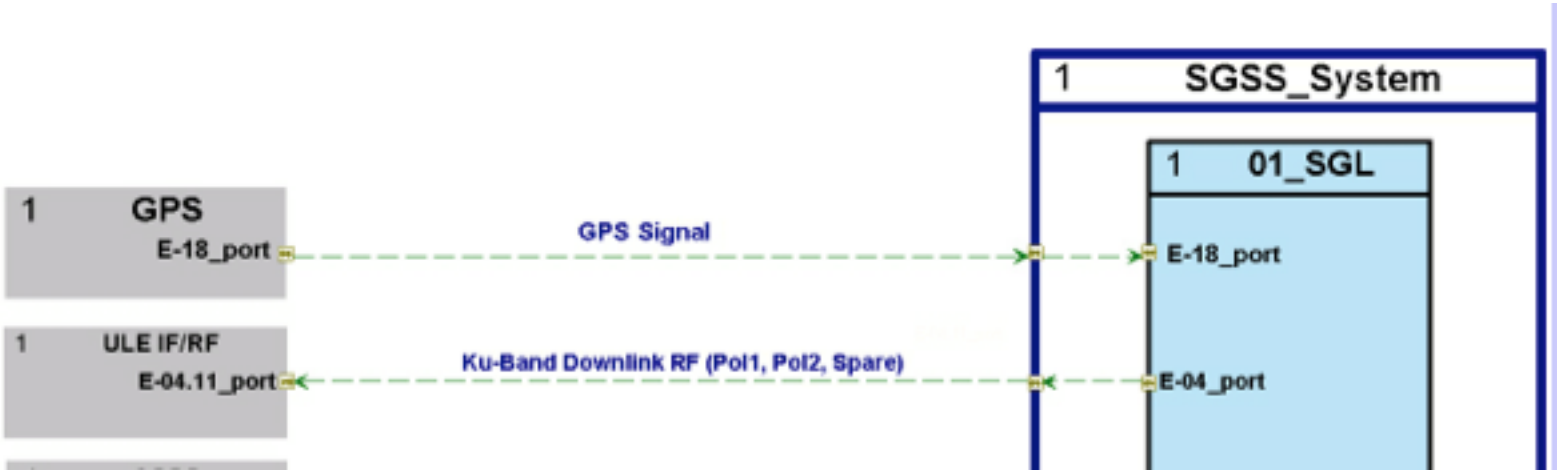
Bearer Data Transport (USG) (1)



Bearer Data Transport (USG) (2)



Bearer Data (SGL)



Note: Refer to Customer Forum #2 for additional presentation information related to interfaces.

Navigating SGSS Documentation

- **External ICDs**
  - Comprehensive, generic description of interface characteristics (e.g., ranges)

ID	External ICD Naming Convention	Notes
E-06	User MOC ICD	Scheduling, vectors, out-of-band service control/monitor
E-05	ULE Baseband (BB)	Processes bearer input/output; includes time/freq ref
E-04	ULE IF	Analog RF(RET only); IF (analog and digital)
E-03	User Platform	Pointers to RF ICDs; payload boundary characteristics
E-01	FDF ICD	Included primarily for tracking data processing/routing

- **User Addenda (to MOC ICD)**
  - <<Mission name>> Addendum
    - Identifies services, SSCs, ports, etc.
    - Points to sections of root addenda for interface definition
- **SGSS Transition Plan (MO-01) User Appendices (to be completed)**
  - <<Mission name>> Appendix
    - Contains User-specific facilities information
- **User Guides (to be completed)**
  - HMIs, instructions for “new” Service Management interface*

*** Note:** Legacy interfaces do not change

User Addenda – Additional Information

- **What to Expect**
  - The addenda are snap-shots of current interfaces for Ground System and the MOC interface connectivity, data formats, message flow, and service specifications. References are documented to identify which area of the main MOC ICD are applicable.
  - Other mission-specific interface aspects are in other documents.
    - Space-to-Space interface(s) [RF ICD]
    - Facility needs [SGSS Transition Plan MO-01]
    - HMIs [SGSS User Guides]
  - SGSS ICDs and Addenda **DO NOT** replace existing Ground ICDs, RF ICDs, and SLAs.
- **How to Help**
  - Each user review their mission addenda for correctness as the initial SGSS interface connectivity, data formats, message flow, and service specifications are defined.
  - Provide comments back to the addenda book manager and be prepared to confirm content for design of the interface design for that addenda.

Scheduling and Scheduling Interfaces
J. P. Chamoun / Mike Prior

Agenda

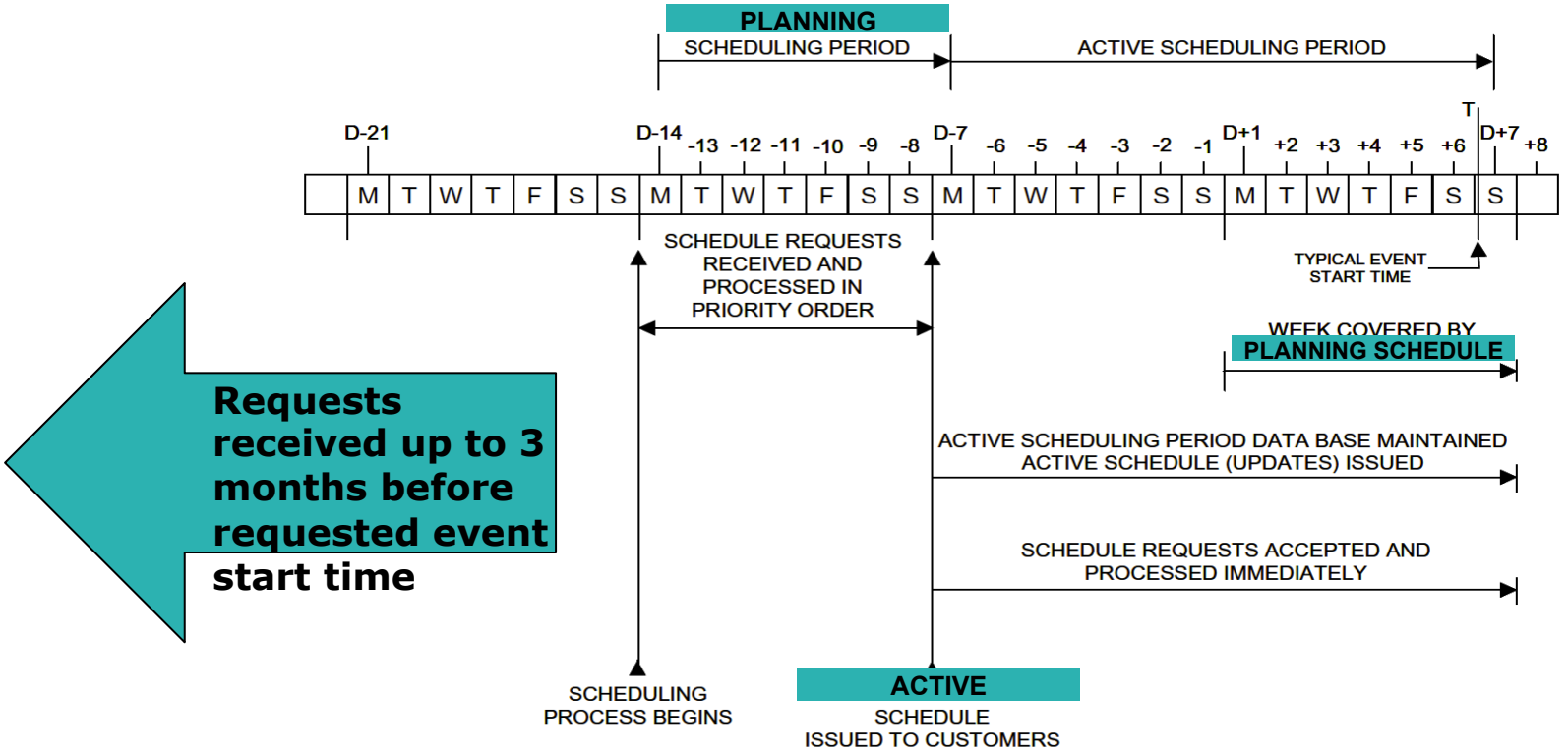
- **Recap of last customer forum**
  - Compare scheduling periods: Today's Vs. SGSS
  - Scheduling Interfaces
  - Transition Period Scheduling Impacts
- **HMIs for Scheduling and Service Control & Monitor**
- **Defining Customer Missions and Scheduling Requirements in SGSS**
  - Migrating legacy customer scheduling data
  - Service Agreement
  - Mission Profile
  - User Service Profile

Scheduling Phases

No changes from last customer forum

Scheduling Periods

- Same scheduling time periods as today
- Requests accepted 3 months in advance
- The term “Forecast” is interchangeable with “Planning”



No impact to current customer scheduling timeline

Scheduling Interfaces

Minor changes from last customer forum

SGSS Scheduling Interfaces

- **SGSS continues to support existing interfaces for existing customers**
  - SN/CSM
  - SNAS/DAS
  - MOC can continue to use their SNAS Clients

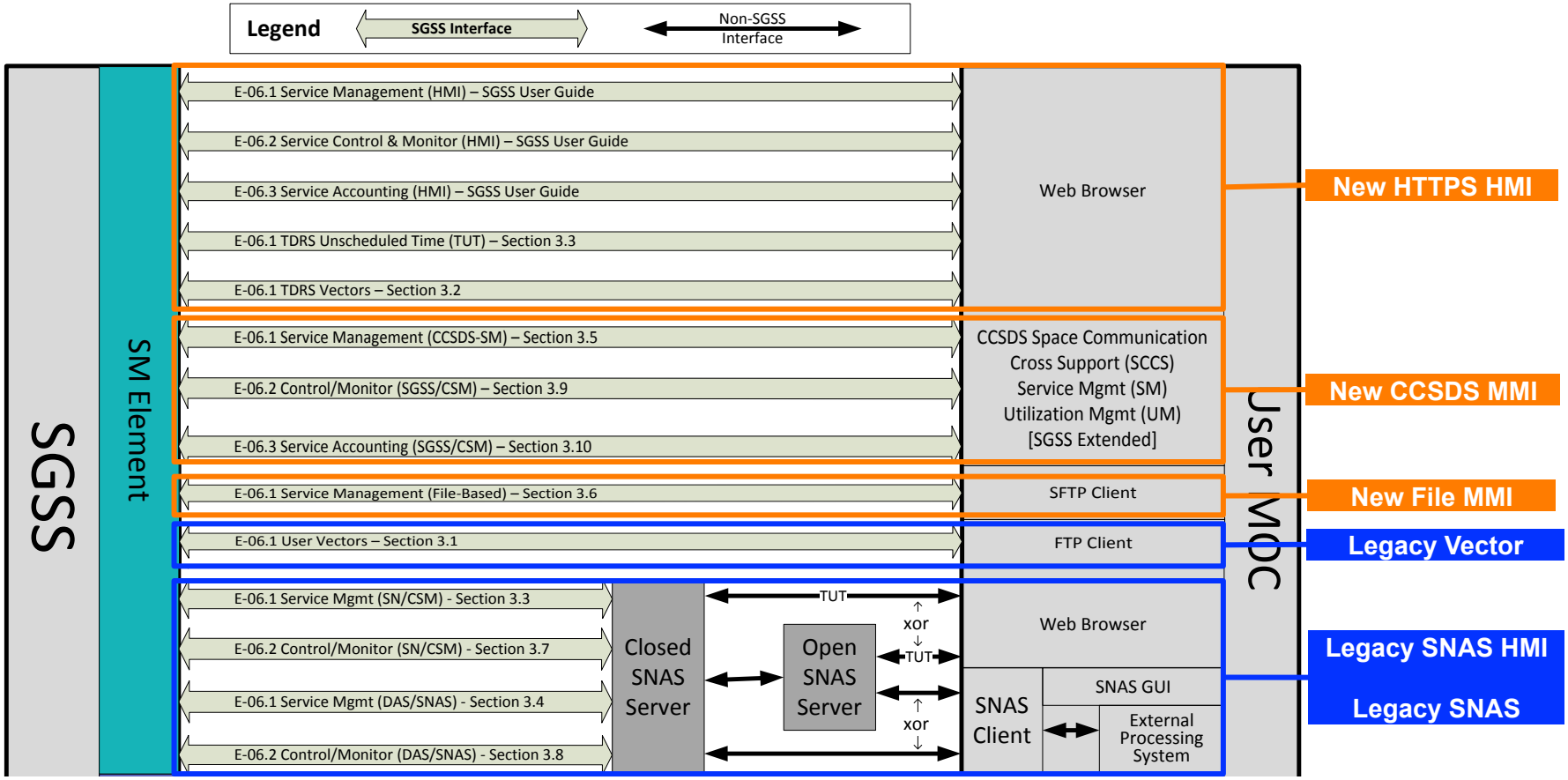
UPDATE: Waitlist and Alternative Schedule Add Requests (ASAR) are not supported in SGSS. Other SGSS features will provide similar functionality

- **SGSS implements new scheduling interfaces and protocols providing the customer additional flexibility for managing and controlling services and the new SGSS service features.**
  - SGSS Web Portal HMI
  - CCSDS Service Management MMI
  - SGSS/CSM MMI

UPDATE: CCSS Service Management is being considered for de-scope as a cost savings measure. There are no current customers for this interface. Design allows for a future add-on interface.

- **SGSS Service Management & Control interfaces provides the following functionality to the customer:**
  - User and TDRS Vector
  - Service Management
  - Service Control and Monitor
  - Service Accounting

Existing Customer Interface Support



SGSS Service Management Status

Where we are since the last customer forum

- **Closed several open items in the E-06 ICD. Working on User Mission ICD Addendum.**
- **Mapping legacy service configuration parameters to SGSS database.**
- **Completed SM HMI mockups and User reviews. Now developing of operational HMI.**
- **Now developing the legacy proxies that will be used to mediate legacy user requests.**

Service Management Terminology

- **Service Management:** this functionality type is used to describe all systems and information used to create service schedules
- **Control and Monitor:** this functionality type is used to describe all systems and information required to configure, execute, and status User Services
- **Human Machine Interfaces (HMI):** this interface type provides graphical displays to input and view scheduling information.
- **Machine Machine Interfaces (MMI):** this interface type provide an electronic connection with customer scheduling systems to receive and provide scheduling information directly to and from the SGSS scheduling system

Customer Operations and Legacy Adapters during Transition

No new impacts from last customer forum

SMLA Operational Scheduling Constraints

- **Scheduling Features impacted during Transition**
  1. Alternate Schedule Add Request (ASAR)
     - ASAR request will be declined: workaround is to resubmit ASARs without referencing a TDRS assigned to the other system (SGSS, SN Legacy)
  2. TDRS Sets (ANY, TES, TW7, TWE, etc.)
     - Schedule requests using cross-system TDRS Sets will be processed but may result in increased declines. Workaround is to resubmit declined requests using specific TDRS
  3. Replace Request (RR)
     - RR request may be declined if the replacement is for a TDRS on the other system. Workaround is to resubmit RR as a SAR (on other system) and SDR (on current)
  4. DAS ANY
     - DAS ANY will not be available during periods when all TDRSs providing DAS support to a customer are not on the same system. Workaround is to use of DAS Specific if customer has only one data port or use of “DAS ALL” if User has multiple data ports
  5. Event/Service overlap between TDRSs
     - Customers that schedule overlapping events between two TDRSs must ensure that unique interface ID’s for CMD/TLM bearer data are scheduled to avoid conflict

The SN is available to assist in scheduling if necessary

HMIs for Scheduling
and
Service Control & Monitor

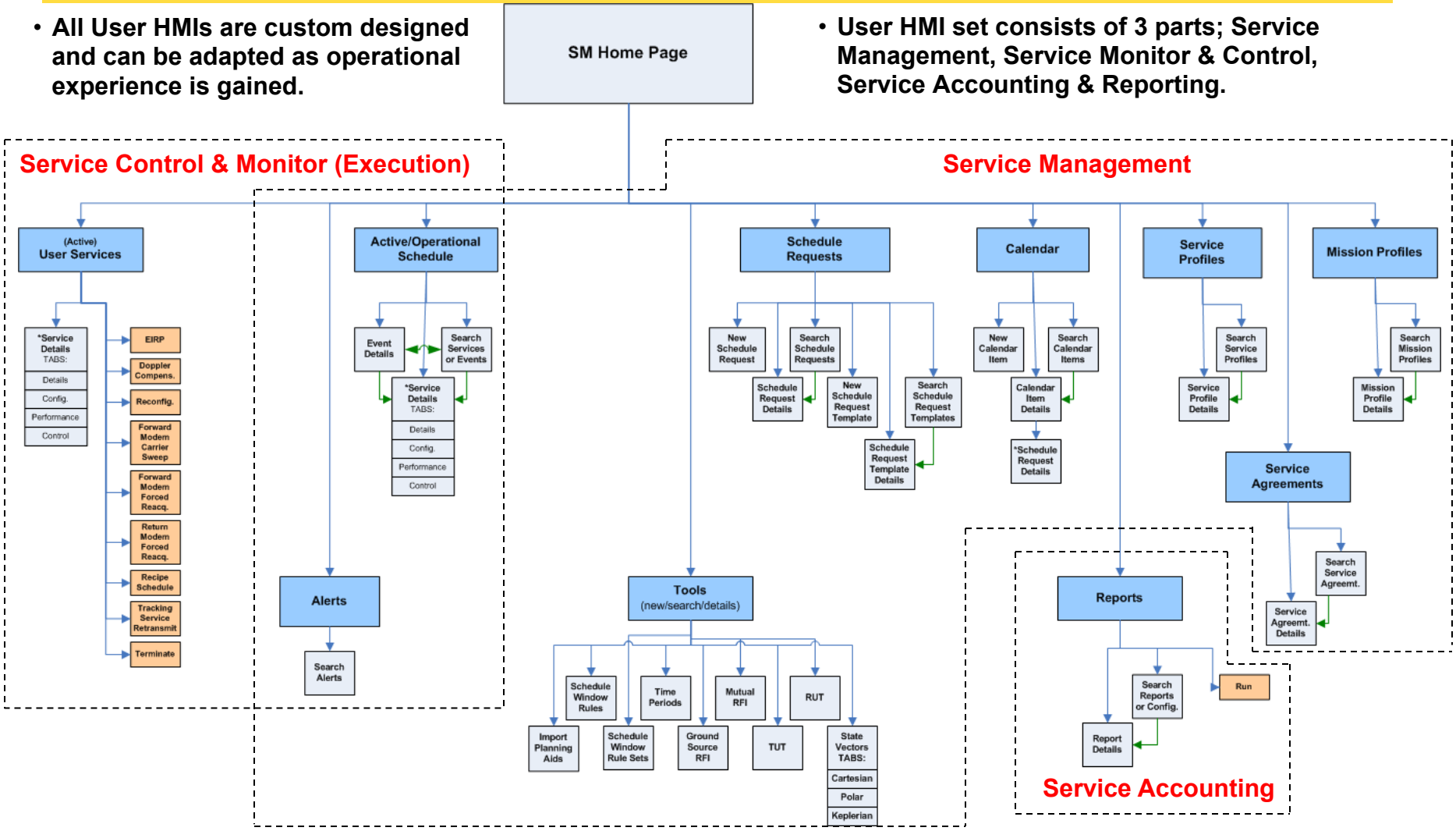
New SGSS Web Portal

- **SGSS implements web portal Human Machine Interface (HMI)**
  - No special user client required. Currently several browsers supported web portal:
    - Mozilla/Firefox, Internet Explorer, Safari (and Safari IOS), Chrome
  - Secure HTTPS and user authentication
  - Modern web based displays
  - Latest scheduling data always available
  - On demand scheduling and service queries
  - Provide the same displays used by the Network Schedulers with the information filtered for the specific user mission or platform
- **Functionality Supported**
  - User and TDRS Vector Management
  - Service Management
  - Service Control and Monitor
  - Service Accounting
- **Interface types provided by Web Portal**
  - HMI

SGSS HMI Overview

- All User HMIs are custom designed and can be adapted as operational experience is gained.

- User HMI set consists of 3 parts; Service Management, Service Monitor & Control, Service Accounting & Reporting.



SGSS HMI Salient Features

- **Provides a rich feature based set of tools that permit Users to manage their SN usage from the highest levels (Mission & Service Profiles, etc.) down to detailed individual service level control and service reporting details.**
- **Design effort has focused upon content and navigation.**
  - Ensure that Users have the content to assess status, make decisions, and efficiently schedule SN resources.
  - Ensure information content and controls are hierarchically arranged to maximize efficiency of use.
- **Many enhanced or new features (compared w/SNAS). Some examples;**
  - Access to all new service features provided by SGSS
  - Calendar provides long term planning of major events and consumed resources.
  - Significant flexibility in setting up user specific scheduling constraints (e.g. split-able, new recurring patterns, etc.)
  - Ability to pre-schedule GCMRs.
  - User can configure custom service accounting reports.
  - TUT summary display with savable search/filtered view settings.
- **WSC Operators and User see nearly identical HMIs.**

Recent & Future User HMI Outreach

- **An extensive series of User HMI design feedback meetings were held during Feb-April of this year that introduced the User interface and the major HMIs. During these meetings the following were covered;**
  - Approximately six 1.5 hours meetings were held with 25 participants from NIMO, ISS, HST, JPSS, and EOS missions resulting in 125 comments submitted.
  - All comments have been closed (accepted for change or clarifications added in design documents).

- **The SGSS Project is planning another live demo of User HMIs.**
  - This will be primarily for User familiarity and not for design feedback solicitation (but any such feedback could be offered).
  - The Demo date is TBD depending upon the I&T schedule but will be hosted via a WebEx type meeting format so participation can be widespread.

Transition to New Scheduling HMI

- **Customers can begin to use the web portal and file based interfaces without having to buy or install special hardware/software.**
- **Web Portal Service Management**
  - Customers can use the web portal to access information more efficiently without impacting operations of their legacy scheduling systems. For example:
    - TUT: access the latest TUT and use the web interface to filter and search for available time for a specific TDRS or service type.
    - Active Schedule: access the latest Active schedule to confirm upcoming activities
    - Calendar: access latest dates for upcoming TDRS/GT transition, outages, etc.
    - Service Profiles: review current definitions (e.g. review service codes)
- **Web Portal Control/Monitor**
  - Customers can use the web portal to access real-time service performance data.

Customers can take full advantage of new web portal displays, while continuing to use legacy interfaces to submit requests.

Defining your Mission Scheduling Needs and Scheduling Parameters

Definition of Scheduling Needs and Parameters

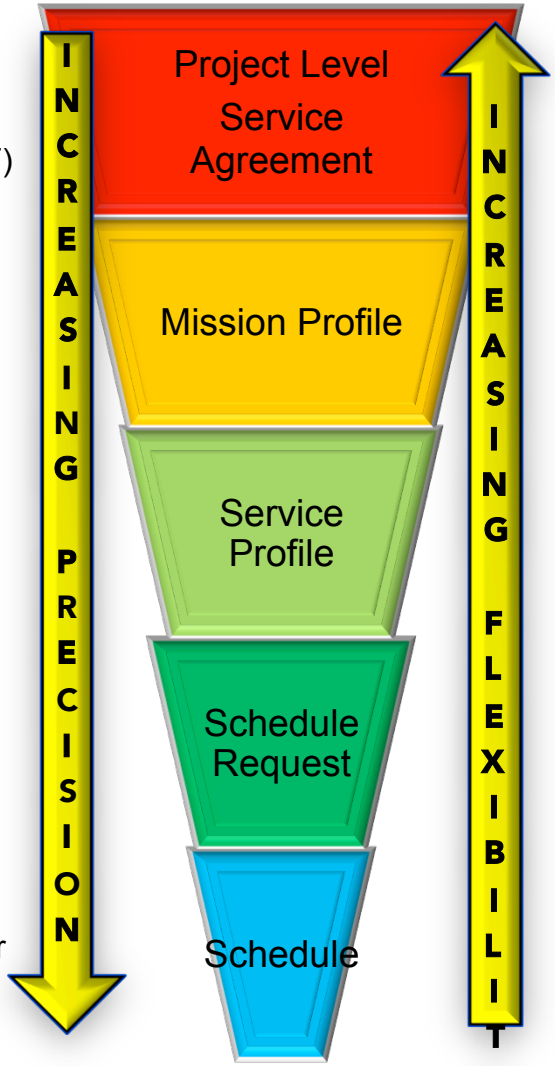
- **The next few slides introduce the SGSS User Mission Definition data elements.**
- **SGSS will work with your mission to ensure all necessary information is correctly captured and migrated**
  - Mission ICD Addendum created to capture all legacy service details
  - Mission ICD Addendum will be validated with corresponding User Mission MOC representatives
  - Mission ICD Addendum will be used to ensure all SGSS elements support legacy scheduling needs
- **SGSS will migrate all user legacy scheduling information**
  - E.g. PSLA parameters, NCCDS database (e.g. SSCs), MDM configs, PTP desktop configs,
- **Customer testing prior to transition will provide additional validation of this data migration. Additional information on Testing and Transition information included in later slides**

Lexicon of Key SGSS Terminology

Term	Definition	Legacy Term/Acronym
Service Agreement Data	A definition of SN usage needs for a user mission agreed upon by both SN and individual user missions.	PSLA, NRD
Mission Profile Data	A collection of parameters applicable to a particular mission, identifies mission characteristics, platforms, etc.	Generally, NCCDS Database Table entries
Service Profile Data	A collection of parameters applicable to a particular service of a particular mission, defines the default values for initial values of that service unless respecified in a request.	SSCs + PTP Desktops/ MDM configs+NCCDS Database entries
Schedule Request	A schedule request is generally drawn from the set {schedule add request, schedule delete request, schedule change request}. A schedule request contains a non-empty list of services.	SAR, SDR, RAR
Planning Period	This is the period of time in which no official schedule exists, but work-in-progress schedule(s) are evaluated to cover this period of time. Although the time boundaries are configurable and shift, this is generally thought of as the period of time 14-21 days in the future. Synonymous with Forecast Period.	Forecast Period
Event	A specified collection of services, with no time periods during which there are no services.	Event
In Progress Service Change Request	A request to alter parameters governing the functionality of a service, while the service is executing.	GCMR, Reconfig Request (DAS)
Service Directive	An instruction from SM to an Element, directing a behavior/function to be performed.	Generally, a SHO/ PSHO

User Mission Definition Data Elements

- **Project Level Service Agreement**
  - Identifies Mission and service needs (e.g. 10 hrs/week contact time)
  - Identifies applicable *service types* available to mission (e.g. KuSAR/KuSAF)
- **Mission Profile**
  - Identifies mission platforms (e.g. FERMI)
  - Provides default values for request parameters (e.g. freeze interval)
  - Enumerates and Restricts types of service profiles to types of services
- **Service Profile**
  - Provides default values for most service parameters (e.g. IPDU encapsulation)
  - Restricts ranges of values for respecifiable service parameters
  - Identifies applicable service recipe, mission profile
- **Schedule Request**
  - Each requested service identifies applicable service profile.
  - Provides (often flexible) times, (often flexible) resources, and (sometimes) respecified values of service parameters (overrides profile values)
- **Schedule**
  - Identifies definitive times and (space, and sometimes ground) resources for each service in a scheduled event, eliminates flexibility that existed in the request, (rare: overrides request)

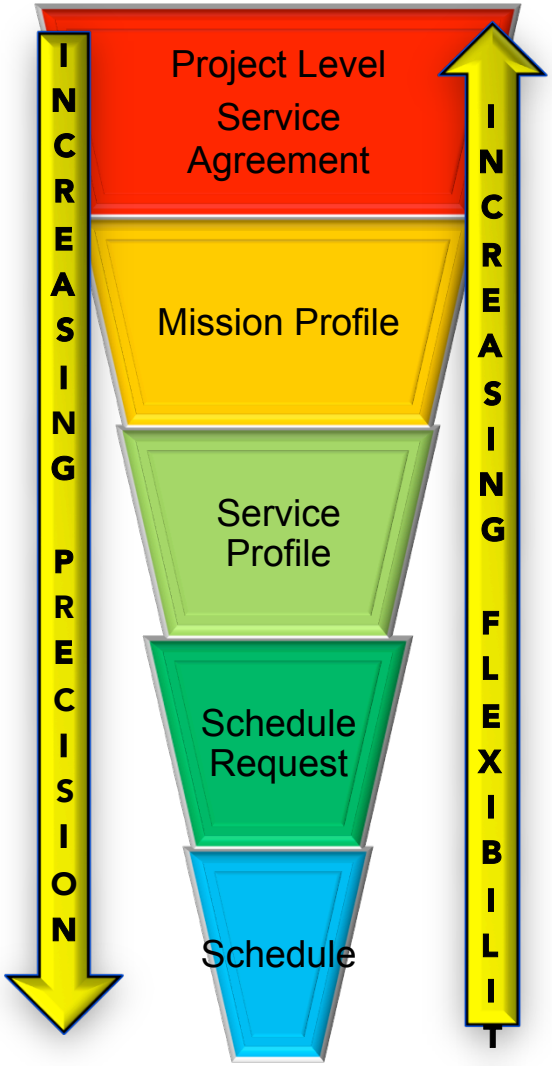


User Mission Definition Example

- SSAR, SSAF (Need 20 hrs per week)

- Hubble Space Telescope (987654321)
- **Freeze Interval of 2 hours**
- **Default RHP (Polarization), LHCP allowed**
- **Default Encapsulation Type IPDU**
- **Default Either SA antenna, SA1 allowed**
- **Default QPSK with data on I and Q Channels**
- **Default Single Data Source, Alternating I/Q**
- **SSAR, TDRS 9 or TDRS 11, SA1**
- **12-25 minutes in duration**
- **Start between 09:00:00Z and 09:30:00Z**

- **TDRS 9, SA1, 16 minutes in duration, Start 09:24:00**



What is next?

- Early review of the Mission Specific Addendum for correctness and completeness will help ensure a successful migration of legacy data into the new SGSS scheduling database is correctly.
- Work with customer missions to ensure all necessary Service Specification Codes are identified for migration into the SGSS database.
- Complete the E-06 ICD and distribute to customers for review.

NISN/IP Addressing
Rodney Marshburn

SGSS Network Changes

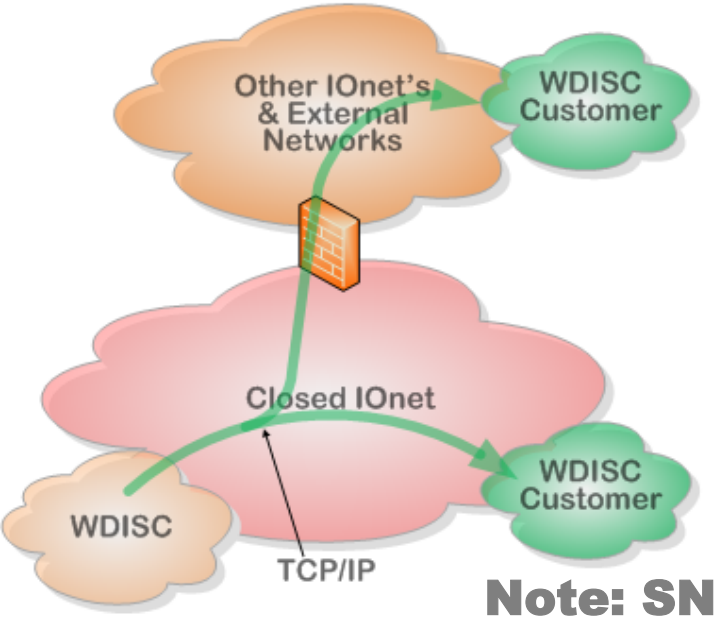
- **NISN is now call Communications Services Office (CSO)**
- **SGSS will exclusively use CSO's new Mission next-generation Architecture (MngA) for network connectivity**
  - **MngA** is fully funded by the CSO Backbone Strategy to be completed early 2015
  - The IONet's will be transitioned to **MngA** 2015 - 2017 under the Mission Backbone Transition (MBT) Project
    - MBT also funded by the CSO Backbone Strategy
  - NSR's are in place to implement SGSS
  - CSO has implemented customer services using this technology as a custom service (it's a proven technology)
- **SGSS has been assigned new IP address space**
  - Users will need to make configuration updates (IP address changes, firewall rule changes, etc.) to connect to the SGSS systems
  - No address changes within the MOC
- **Users MOCs whose systems are located on the Open, Restricted, or Closed IONets will be required to submit CSO firewall rule requests to establish connections to SGSS**

All configuration modifications required by customers to connect to SGSS will be coordinated using one on one meetings

Notional WDISC Transition

Current WDISC Flows

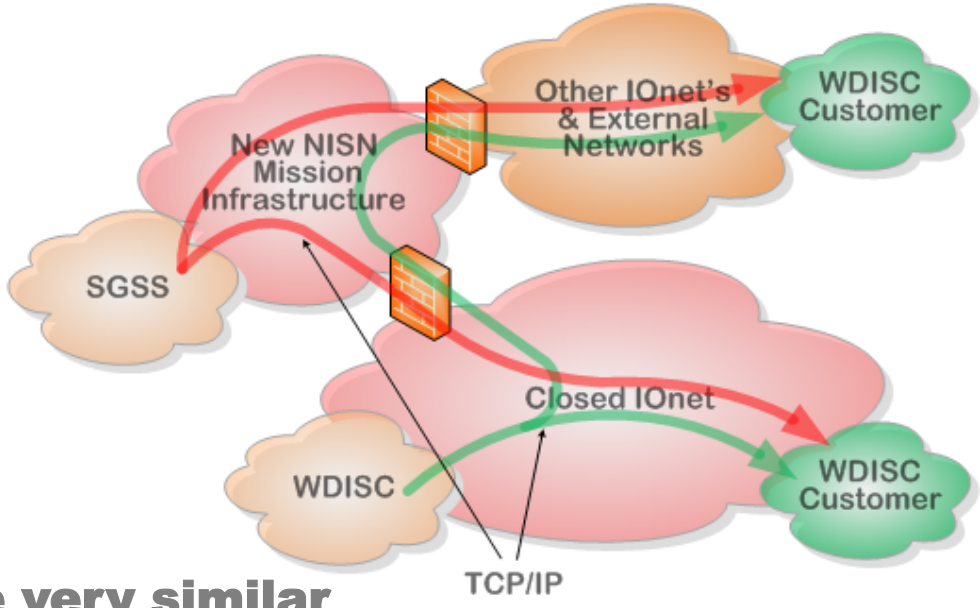
Arrow indicates who opens the connection



WDISC Flows during SGSS Transition

Green is with legacy WDISC

Red is with SGSS

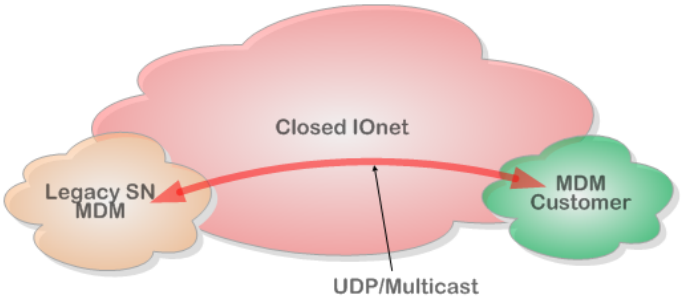


Note: SNG will be very similar

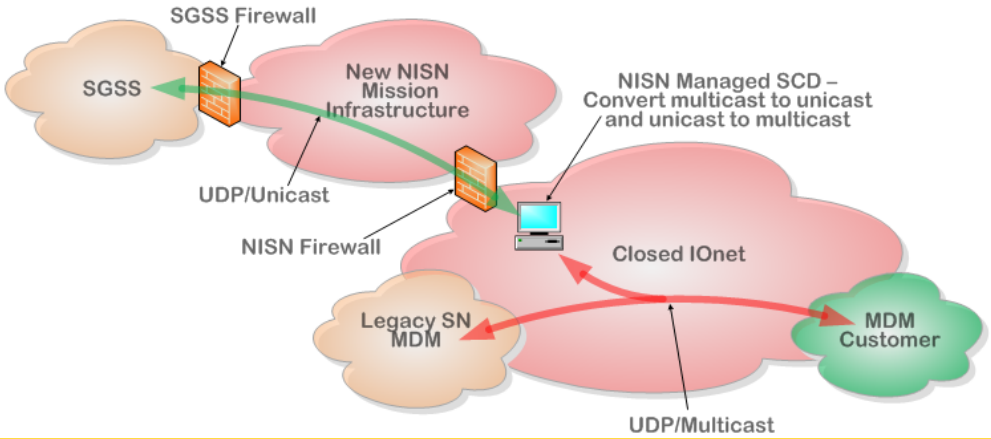
IP address and Firewall rule changes will be needed by customers

Notional MDM Transition

Current MDM Flows



MDM Flows during SGSS Transtion



No Expected Changes for MDM customers

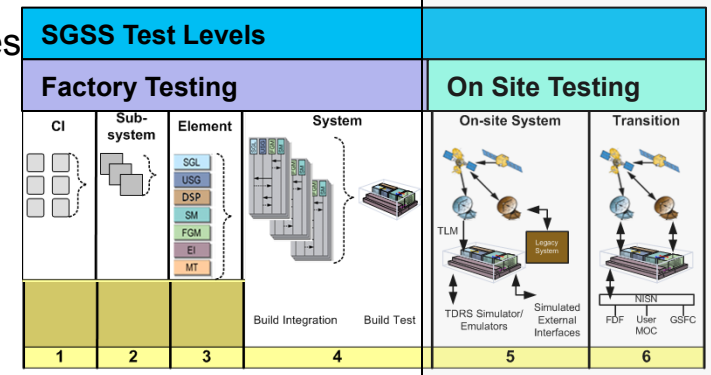
Transition Period and Customer Testing
Bob Gonzales

Contents

- **Customer Forum #2 Highlights**
- **System Verification & Validation Testing**
- **Customer Transition & Testing**
- **MO-01 Transition Plan Appendices**
- **Transition Timeline Overview**
- **Transition Period Details**
  - Pre-Deployment
  - Pre-Transition
  - NISN/SMLA Transition
  - L5/L6 Testing
- **Summary & Plan Forward**

Customer Participation in Level 5 & 6 Testing (from Forum #2)

- **SGSS uses a progressive buildup of test levels similar to what's been done for other SN development projects**
  - Level 1-4 involves lower level factory testing and does not involve direct interfaces with the customers
    - If Customers have MOC simulators they are invited to participate during level 4 testing.
  - Level 5 On Site Verification Testing
    - Re-verifies the system after relocation to the operational site
    - Customer Participation begins to verify interfaces
  - Level 6 On Site Validation Testing
    - Navigation acceptance testing conducted with FDF
    - Will work with each customer to establish validation criteria for Level 6
    - Project initial criteria is one successful test per customer scenario
- **Level 5 and 6 Testing conducted for each ground terminal antenna and tailored as described previously**



Customer Participation

- **External Interface Data Flow Tests**
  - **SM**
  - **CMD/TLM bearer data**
- **Shadow Tests**
- **End to End Tests with customer spacecraft and MOC**

Successful customer interfaces verification and operational support validation a key focus of on site testing

Transition and Customer Participation in Testing (from Forum #2)

- **Customer Participation Levels**
  - Estimation of Participation Levels
    - Significant (estimated ~4-8 test activities per customer)
      - Testing of all aspects of the service management interface
      - Testing of operational events that cover key customer scenarios (e.g. nominal, TT&C only, emergency/contingency)
    - Moderate (estimated ~2-3 test activities per customer)
      - Regression testing of the service management interfaces
      - Testing of one representative customer scenarios (e.g. nominal)
    - Minimal (estimated ~1 test activity per selected customer)
      - Testing representative customer configuration
  - Customer interchange meetings will be planned to further define the test plans, customer scenarios, test/operational constraints and other special considerations.
  - On a case by case basis exceptions will be made, and testing will be accomplished using alternate test resources (e.g. End to End tests, SCaN Test bed, ESTL).
  - Customers will be invited to participate in the ORR's

Test Activities include:
- **SM/M&C Engineering Interface Tests**
- **Ping tests**
- **Data flows**
- **Customer event supports**

SGSS Verification & Validation Testing

- **L4 / L5 / L6 testing will *verify* the SGSS system level requirements**
  - Preliminary Test Plans (IT-02's) have been submitted and approved
  - System testing will demonstrate functionality, performance and interfaces using test antennas, user simulator antennas, and ground antennas
  - All required modes, data rates and interfaces will be verified at the system level prior to customer participation

- **Testing with SN customers will *validate* that the SGSS product satisfies its intended use when placed in its intended environment**
  - Full two-way interfaces with operational systems will be used for the validation of the SGSS

- **Customer-specific validation testing may occur concurrently with the system verification testing**

Customer Transition & Testing

- **During the operational transition and test period, customers will be supported on both legacy SN and SGSS systems**
  - There are some complexities during transition that result in some minor, temporary constraints with workarounds
- **Deployment & Transition (D&T) team is cognizant of the unique aspects of each mission, such as:**
  - User Data & Timing Interfaces
    - NISN interface Transition (4800BB, WDISC, SN Gateway, DAS, …)
    - LI port transition (ECL, TTL, IF, …)
  - Management & Control Services
    - Scheduling (SNAS, Direct Connect, …)
    - Real-time Control & Monitor (UPD, GCMR, …)
    - Time & Frequency (1 PPS, 10MHz, …)
    - Ephemeris & Tracking Data
  - RF Interfaces
    - Forward & Return Services

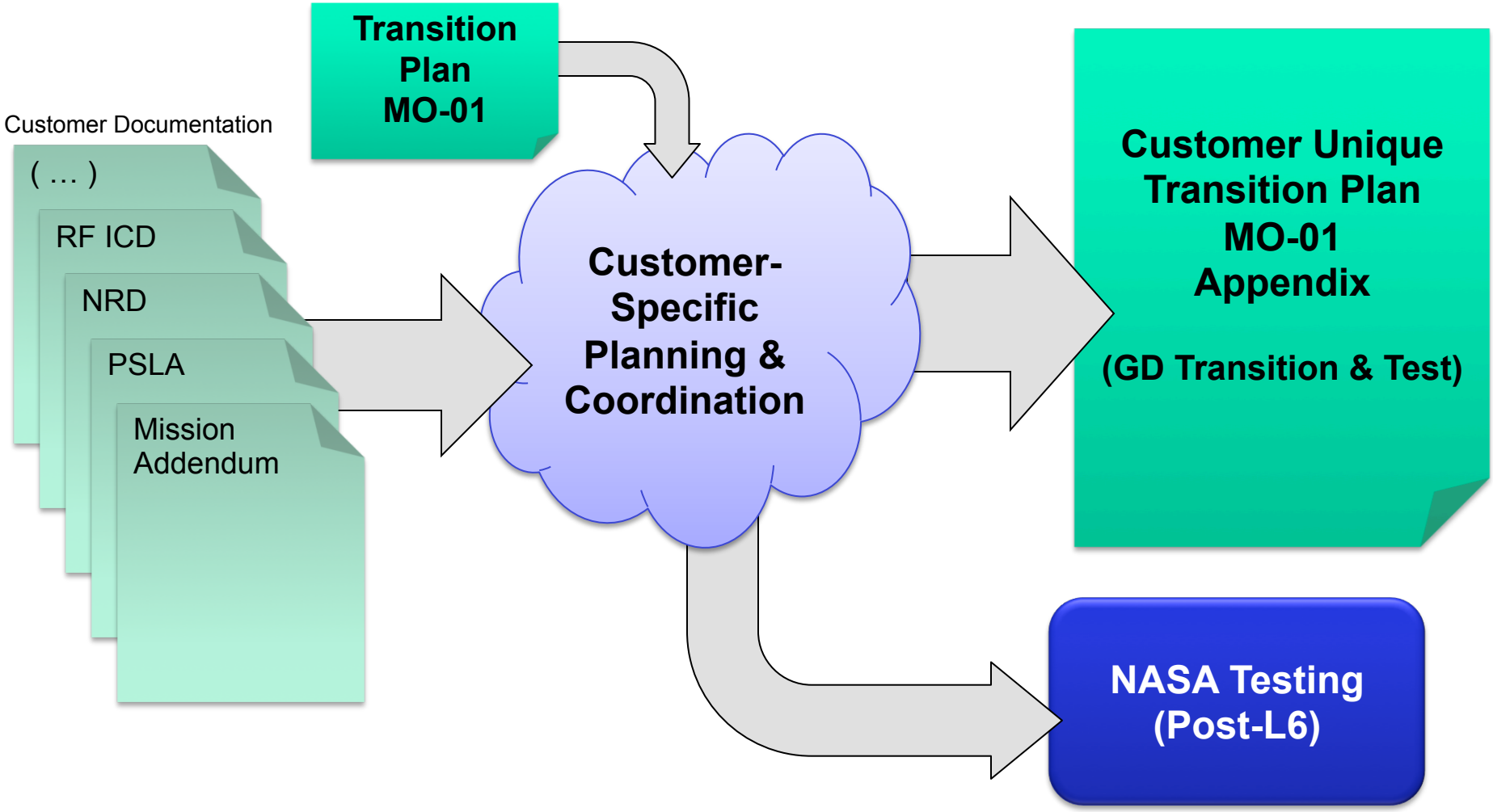
D&T will proactively work with each customer to make this a successful transition

MO-01 Transition Plan Appendices

- D&T will coordinate and generate unique customer-specific appendices to the MO-01 Transition Plan.
- Appendix contents will be coordinated and developed with the customer to baseline their expectations and participation in the SGSS system testing. Contents include, but are not limited to:
  - User data interface transition details
  - NISN reconfiguration details (i.e. direct IP vs. DNS naming)
  - Coordinate participation during the SMLA/ANCC confidence testing
  - Specification of participation constraints (i.e. geographic, specific TDRS, or scheduling constraints)
  - Subset of Service Profiles to be executed during GD L5/L6 testing
- The MO-01 appendices will be organized around specific tasks to assist and guide each customer throughout the transition periods

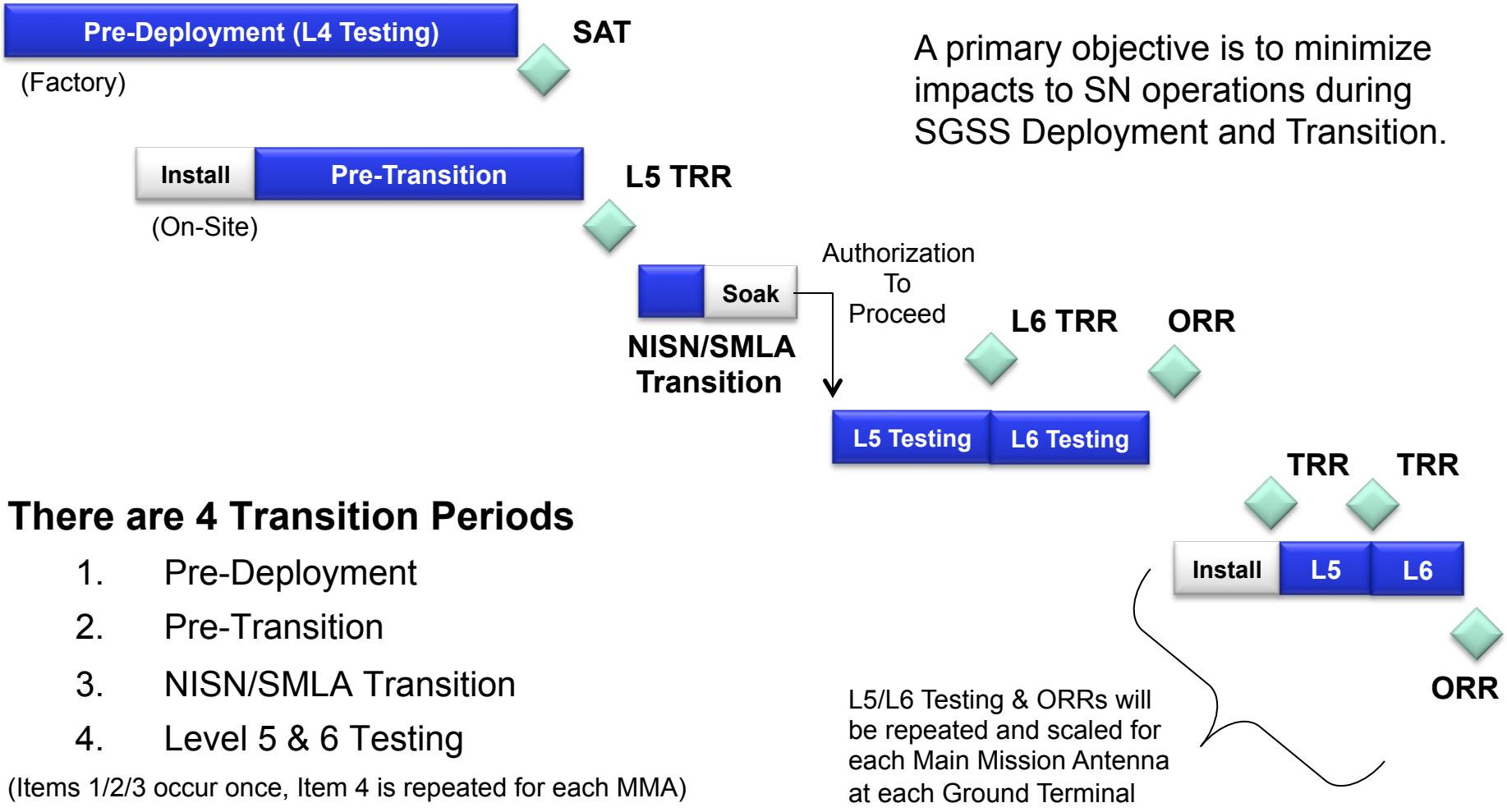
Customer participation is key to successful transition to SGSS

Appendix Development



Unique appendices to the Transition Plan (MO-01) will be created for each customer

Transition Timeline Overview



A primary objective is to minimize impacts to SN operations during SGSS Deployment and Transition.

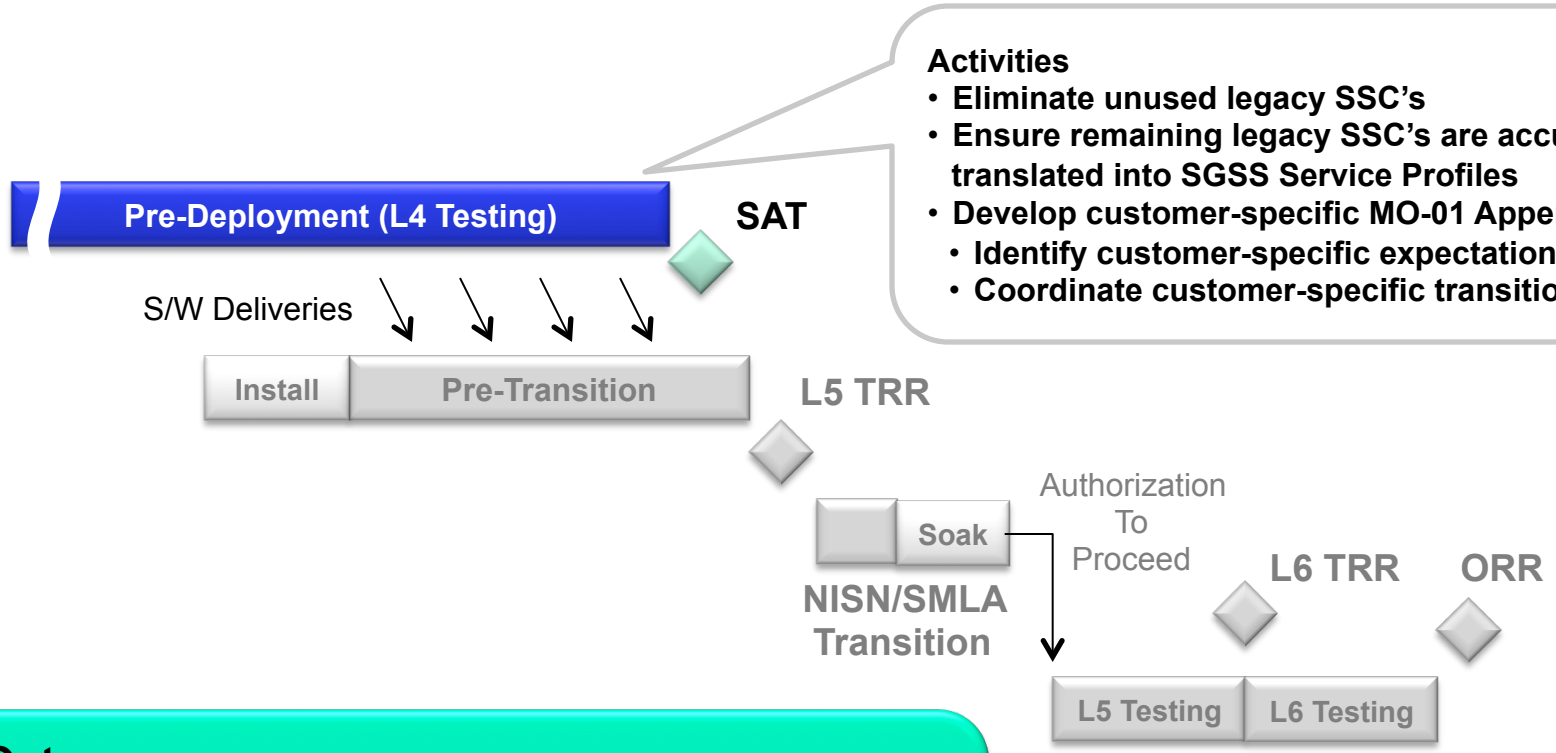
There are 4 Transition Periods

1. Pre-Deployment
2. Pre-Transition
3. NISN/SMLA Transition
4. Level 5 & 6 Testing

(Items 1/2/3 occur once, Item 4 is repeated for each MMA)

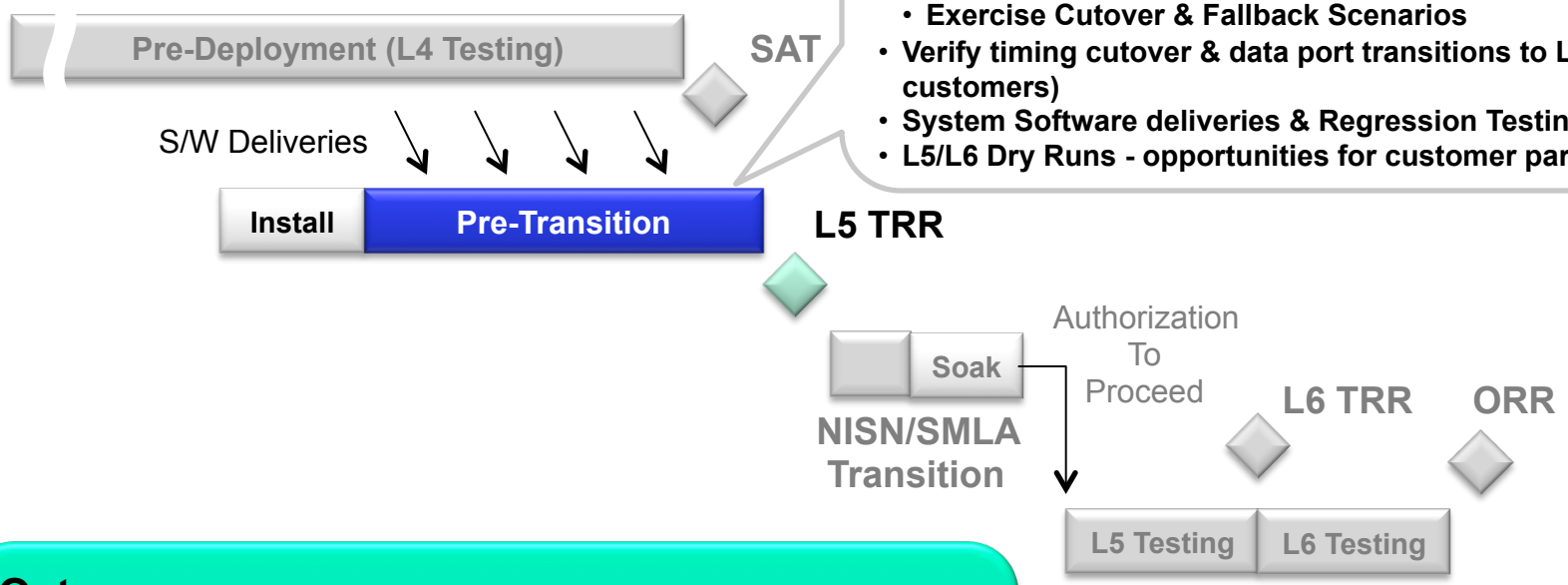
All 4 Transition periods provide opportunity for customer participation

Pre-Deployment Period



Outcome:
- **Baselined MO-01 Appendices**
- **Validated SGSS Service Profile Database**
- **Successful SGSS system-level testing**
- **Formal (L4 system tested) S/W delivery**

Pre-Transition Period



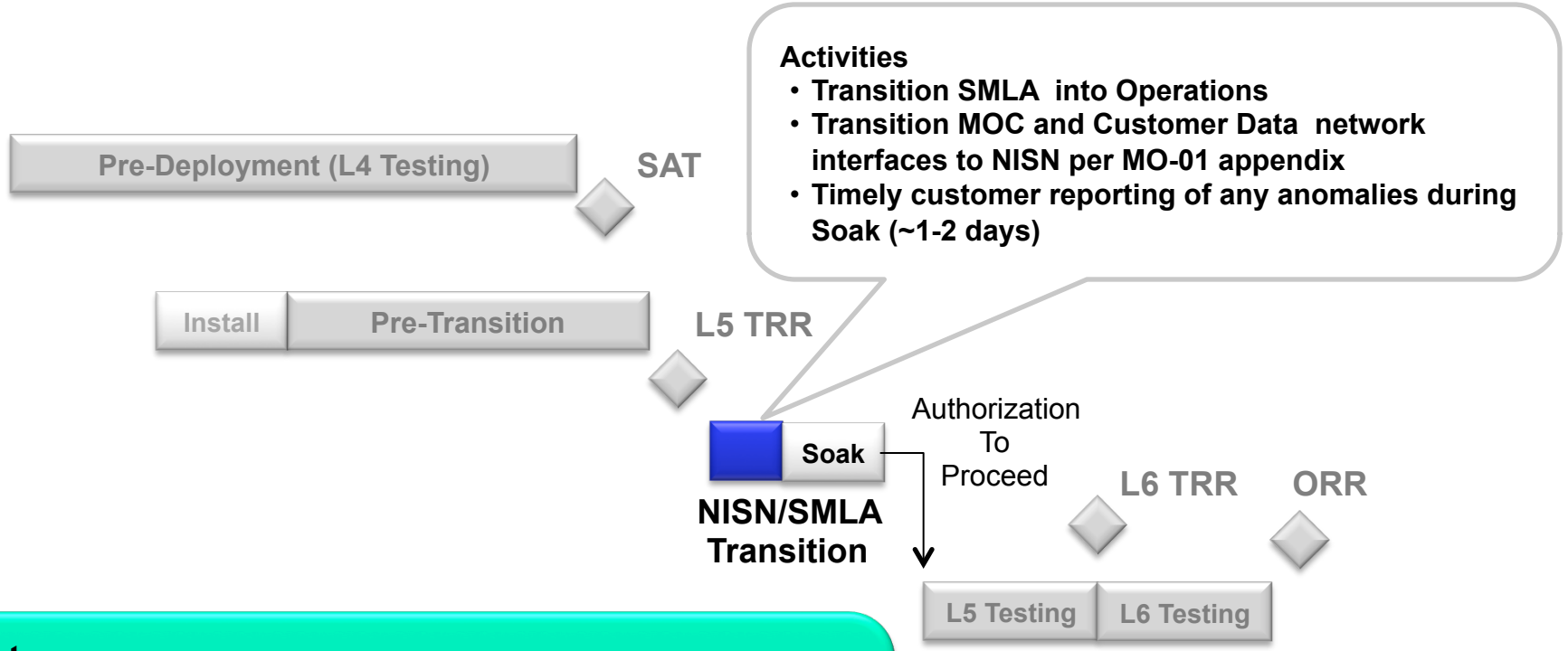
Activities

- SMLA Confidence testing using ANCC & SGSS SNOC
  - Schedule Acceptance & Feedback, GCMRs, UPDs, Vector Transmissions
  - Exercise Cutover & Fallback Scenarios
- Verify timing cutover & data port transitions to LI (ULE customers)
- System Software deliveries & Regression Testing
- L5/L6 Dry Runs - opportunities for customer participation

Outcome:

- SMLA Risk Mitigation complete
- L5/L6 Dry Runs complete
- LI Port Cutovers complete (site specific)
- SMLA transition to Operations is authorized

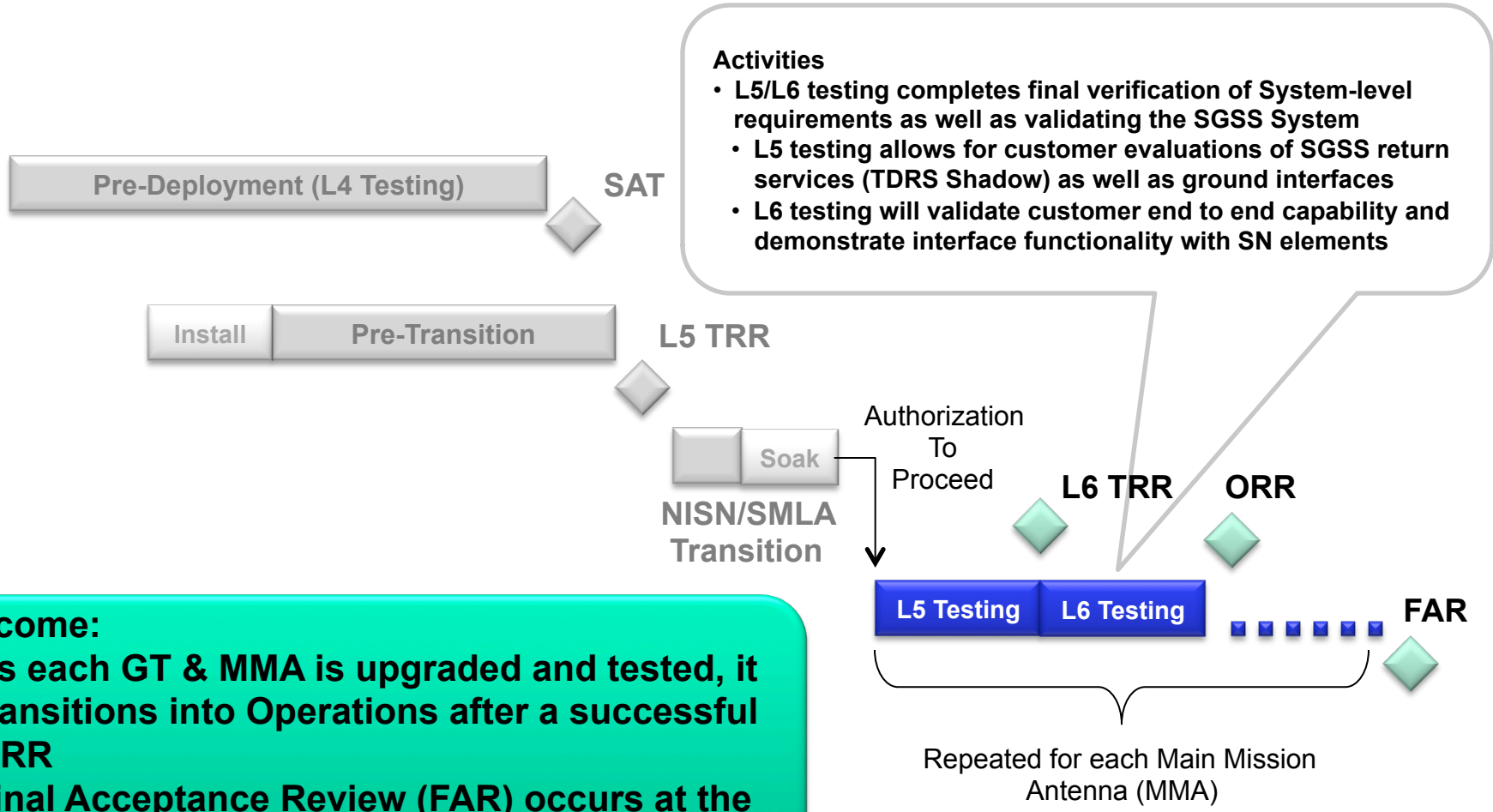
Transition Period



Outcome:

- **SMLA is now routing all traffic to/from Legacy & SGSS**
- **SGSS authorized to proceed into L5 & L6 Testing**

L5/L6 Test Period



Outcome:

- **As each GT & MMA is upgraded and tested, it transitions into Operations after a successful ORR**
- **Final Acceptance Review (FAR) occurs at the end of all testing.**

Customer Participation Summary

Title	Transition Activity	Transition Period
Timing & Freq.	Timing System Cutover	3
User Local Equip.	ULE Port Cutover to USG-LI	2
MOC Network	NISN Connectivity Cutover	3
Management Services	Service Scheduling	1, 2, 3, 4
	Ephemeris - IIRVs	2, 3, 4
Control Services	Real Time Service Control and Monitor	4
	Tracking Data	4
	Time and Frequency References	4
Forward Link Bearer Plane (FLBP)		
FLBP Ground Link Services (Data Format)	ULE Interface	2, 4
	Baseband MOC Interface	4
FLBP Space Link Services (Signal Processing)	Data (Bit, Frame) Processing	4
	Symbol Processing	4
	Modulation	4
FLBP Space Link Services (RF Tx/Rx)	TDRS to User Platform RF Tx	4
Return Link Bearer Plane (RLBP)		
RLBP Ground Link Services (Data Format)	ULE Interface	2, 4
	Baseband MOC Interface	4
RLBP Space Link Services (RF Tx/Rx)	User Platform to TDRS RF Rx	4
RLBP Space Link Services (Signal Processing)	De-Modulation	4
	Symbol Processing	4
	DQM, Frame/Frame Sync Processing	4
RLBP Record and Retrieve Services (Data Format)	Record / Playback / Retrieve MOC Interface	4

Transition Periods

1. Pre-Deployment
2. Pre-Transition
3. NISN/SMLA Transition
4. Level 5 & 6 Testing

Summary & Plan Forward

- **Summary:**
  - The main body of the SGSS Transition Plan (MO-01) currently contains the system-level efforts for transition. The customer-specific appendices to MO-01 will capture all of their mission-unique transition and test details.
    - The appendices will be derived in large part from existing documentation with emphasis on the USWG-generated Mission Addendums as they have been most recently prepared, reviewed, and validated
  - The D&T team will utilize the MO-01 Appendices as a guideline for the creation of their customer-specific test procedures and as a checklist to ensure customer expectations have been addressed

- **Plan forward:**
  - Define roles & responsibilities
  - Establish MO-01 Appendix template for customer specific test & transition planning
  - Continue collaboration of SSC DB scrub process

Next Customer TIM

Next Customer TIM (#4)

- **Next Customer TIM will focus on:**
  - Updating SGSS status and plans
  - Continued maturation of Customer interface definitions
- **Targeting 1nd quarter of 2014**

Wrap Up

- **Continue review, comment and secure approval of the MOC ICD**
- **Periodically check the website (below) for this presentation package as well as SGSS newsletters**

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http://esc.gsfc.nasa.gov/space-communications/sgss.html

Acronyms

ADC	Analog to Digital Converter
Amp	Amplifier
ANT	Antenna
ATF	Australian TDRSS Facility
BPGT	Blossom Point Ground Terminal
BRTS	Bilateration Ranging Transponder System
CCSDS	Consultative Committee for Space Data Systems
CDR	Critical Design Review
COTS	Commercial Off the Shelf
CSM	Customer Service Management
DAC	Digital to Analog Converter
DAS	Demand Access Service
DSP	Digital Signal Processing
EET	End to End Test
EI	Enterprise Infrastructure
ETGT	Extended TDRSS Ground Terminal
FAR	Final Acceptance Review
FDF	Flight Dynamics Facility
FE	Front End
FGM	Fleet and Ground Management
FTP	File Transfer Protocol
FW	Firmware
GHz	Gigahertz
GRGT	Guam Remote Ground Terminal
GSFC	Goddard Space Flight Center
GT	Ground Terminal
HMI	Human-Machine Interface
HTTP	Hypertext transfer Protocol
HW	Hardware
ICD	Interface Control Document
IF	Intermediate Frequency
IFL	Interfacility Link
IP	Internet Protocol
IRD	Interface Requirements Document
LAN	Local Area Network
M&C	Monitor and Control

M	Modulator
MMI	Machine-Machine Interface
MOC	Mission Operations Center
MTF	Maintenance and Training Facility
NCCDS	Network Control Center Data System
NISN	NASA Integrated Services Network
PDR	Preliminary Design Review
PSNOC	Primary Space Network Operations Center
SGL	Space Ground Link
SGSS	Space Network Ground Segment Sustainment
SLE	Space Link Extension
SM	Service Management
SN	Space Network
SNAS	Space Network Access System
SNGS	Space Network Ground Segment
SNOC	Space Network Operations Center
SSC	Service Specification Code
SSPA	Solid State Power Amplifier
STGT	Second TDRSS Ground Terminal
SW	Software
TCP	Transmission Control Protocol
TDRS	Tracking Data Relay Satellite
TTC	Tracking Telemetry and Command
TUT	TDRS Unscheduled Time
UDP	User Datagram Protocol
ULE	User Local Equipment
USG	User Services Gateway
VITA-49	VITA Technologies Radio Transport Standard V49
VM	Virtual Machine
WSGT	White Sands Ground Terminal
XML	Extensible Markup Language
µTCA	MicroTelecommunications Core Applications (MicroTCA)